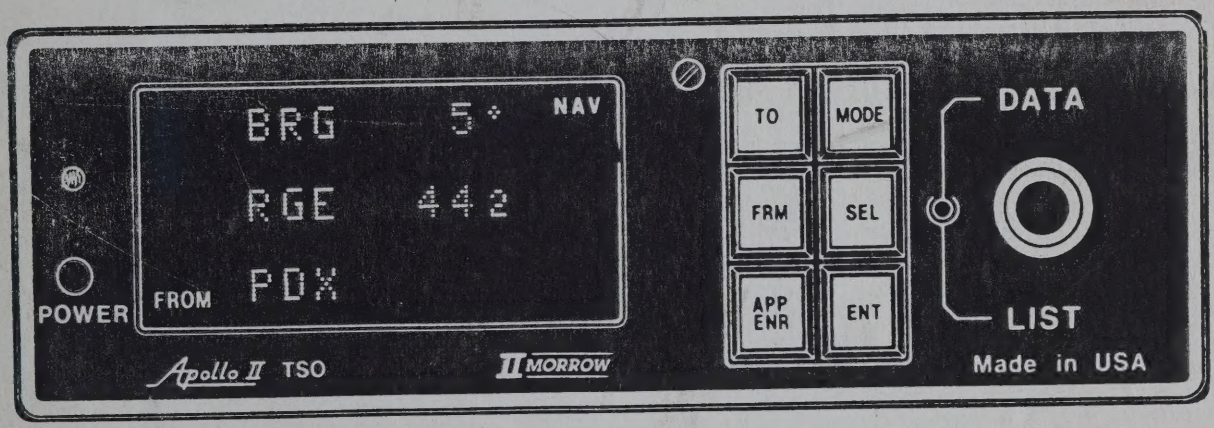
Apollo II

LORAN-C NAVIGATION SYSTEM

MODEL 612A

INSTALLATION MANUAL



TIMORROW INC.

SALEM, OREGON U.S.A.

MANUFACTURER OF QUALITY NAVIGATION AND COMMUNICATION SYSTEMS

0387

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INSTALLATION MANUAL

SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides information about the electrical, mechanical, and physical characteristics as well as installation procedures for the APOLLO II Model 612A LORAN-C Navigation System by II Morrow, Inc. Follow the procedures recommended in this manual for successful installation and optimum performance.

1.2 EQUIPMENT DESCRIPTION

The APOLLO II is a panel mounted LORAN-C receiver as illustrated in Figure 1. A slotted screw secures the APOLLO II to the mounting frame. Removal of the screw allows for the easy transfer of the receiver.

The FC-02 Low Level Flag Adapter and the A-16 LORAN-C Whip Antenna by II Morrow Inc. are included with the APOLLO II Model 612A package. The FC-02 is used to interface the APOLLO II Model 612A with CDIs that have separate TO/FROM and NAV VALID flags. The A-16 is the standard antenna and is rated to 350 kts (TAS). The A-17 LORAN-C High Speed Blade Antenna is rated to 521 kts (TAS). The A-23 LORAN-C Bent Whip Antenna is rated to 350 kts (TAS).

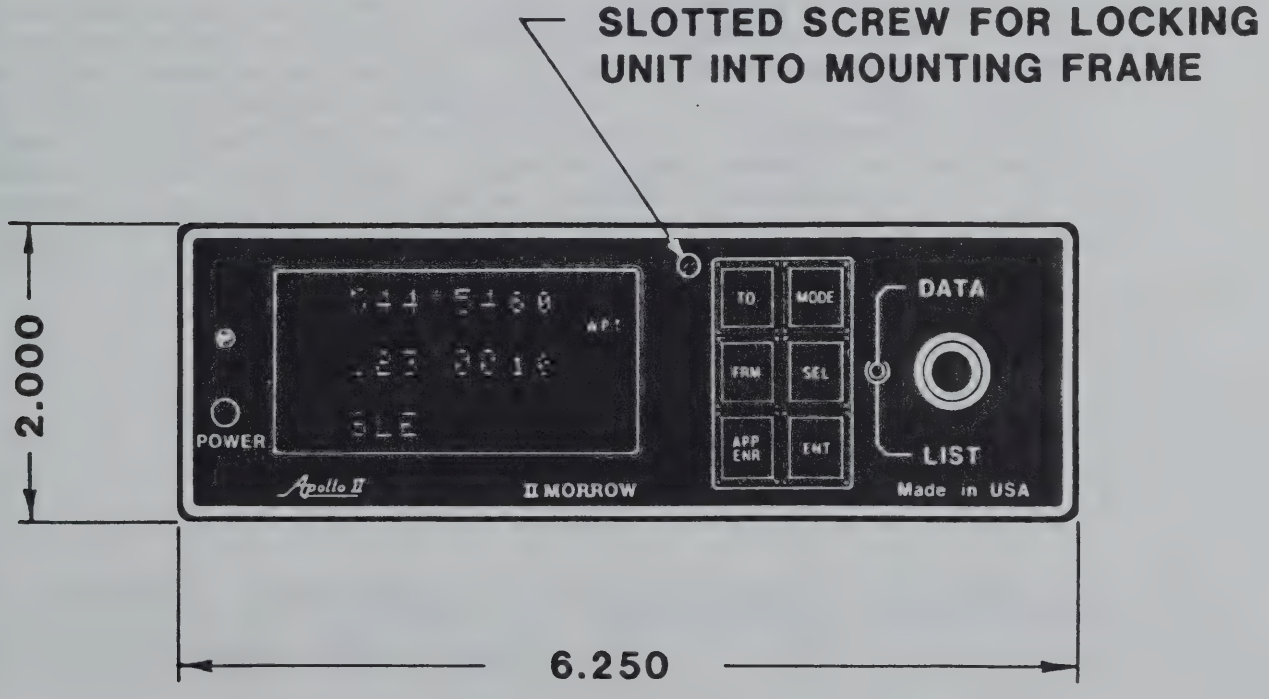


Figure 1

The APOLLO II functions as an area navigation device with position location derived by a LORAN-C receiver on the 100 kHz radio frequency transmitted by land-based stations. The APOLLO II enables the operator to utilize point-to-point navigation independently of terrain or altitude.

The APOLLO II package consists of the LORAN-C receiver, the mounting frame, and an antenna optimized for LORAN-C reception. The A-16 LORAN-C Whip Antenna is the standard antenna included with the APOLLO II Model 612A. The A-17 LORAN-C High Speed Blade Antenna and A-23 Bent Whip Antenna are available as options.

The APOLLO II using the FC-02 Low Level Flag Adapter can be interfaced with standard low level course deviation indicators (CDIs) and horizontal situation indicators (HSIs) with autopilot interface capability.

The APOLLO II displays your present position in Latitude/Longitude coordinates, bearing and range to the destination or origin, track angle, ground speed in knots, cross track error, and estimated time enroute to your destination.

State-of-the-art, large scale integrated circuitry produces an extremely compact unit: size (H - 2", W - 6.25", D - 11.2"); weight - 3.75 lbs; with a nominal power consumption of 15 watts from an input voltage of 6.5 VDC to 48 VDC.

Additional features include: a continuous memory containing all federally-designated airports and VORs in the continental U.S., 100 user programmable waypoints, automatic secondary selection, automatic magnetic variation adjustment, Two-leg flight planning with automatic sequencing, and an automatic brightness control for ambient light conditions. User entered memory is kept alive by an internal battery which has a nominal lifecycle of approximately 5 years.

Due to II Morrow's commitment to constantly improve the quality and performance of our equipment all specifications and features are subject to change without notice.

1.3 TECHNICAL SPECIFICATIONS

1.3.1 APOLLO II RECEIVER

1.3.1.1 ELECTRICAL CHARACTERISTICS

POWER

1. Operating Range
   6.5 VDC to 48 VDC negative ground
   15 Watts nominal
2. Maximum A-Line Power Consumption
   1.09 A Nominal at 13.75 VDC
   0.54 A Nominal at 28 VDC

INTERFACES

Course Deviation Indicator or Horizontal Situation Indicator with Autopilot Interface

1) Course Deviation Loads
   1 to 5 1K ohm loads
   ±150 uA full scale
2) Valid Flag Loads
   1 1K ohm load
   ±260 uA for flag out of view

External Annunciators (LORAN WARN, WAYPOINT ALERT, LORAN VFR, and APPROACH)
Max. 180 mA sink current each
Max. 30 VDC

RS-232 Serial Data Output Interface
Data is asynchronous, 1200 baud
Signal level is 0 to +5 Volts

1.3.1.2 ENVIRONMENTAL CATEGORIES (DO-160A)

Temperature and Altitude	A1,B1
Humidity	A
Vibration	PKS
Magnetic Effect	Z
Power Input	BZ
Voltage Spikes	A
AF Susceptibility	Z
Electromagnetic Compatibility	Z

1.3.1.3 SOFTWARE CRITICALITY CATEGORY (DO-178A)

Software Level 2
Essential Category

The software version listed in the Flight Manual Supplement has been developed to meet installations for essential level.

1.3.1.4 PHYSICAL CHARACTERISTICS

1. Weight: 3.678 lbs (1.668 kg) includes mounting frame
2. Size: Height - 2.0 inches (5.08 cm)
   Width - 6.25 inches (15.88 cm)
   Depth - 11.2 inches (28.45 cm)
   (Depth is from back of front panel to rear of mounting frame)
3. Mounting: Panel

1.3.1.5 OPERATIONAL CHARACTERISTICS

Operating Temperature - -15°C to +55°C (5°F to 131°F)
Operating Humidity - 95% at +50°C (122°F)
Operating Altitude - 35,000 feet (10,668 m)
Track Speed - 600 knots at 0 dB SNR
Time to Track (GRI 9940)
2 minutes at 0 dB SNR typical
3½ minutes at -10 dB SNR typical
Update Rate of Current Position - 0.5 seconds nominal
Position Repeatability - 0.01 nm typical for primary LORAN-C areas
Range Resolution - 0.1 nm (600 feet)
Cross Track Distance Resolution - 0.01 nm (60 feet)
Cross Track Distance Display Resolution -
Selectable: in 0.01 nm increments up to 1.00 nm

CDI Display - Enroute ±5.0 nm Full Scale
Approach ±1.25 nm Full Scale

Memory - Continuous supplied by internal Lithium battery
Nominal life approximately 5 years

Waypoints (In Lat/Long coordinates):
FLYBRARY (All federally designated airports and VORs plus 100 user programmable identified by 4 alphanumeric characters), PPTO, and PPFR

Notch Filters - 8 Internal (Factory Preset)
Displays - High Intensity Alphanumeric Dot Matrix
Push Buttons - Backlighted

1.3.1.6 RECEIVER SPECIFICATIONS

Dynamic Range - 110 dB
Noise Bandwidth - 23 kHz at receiver output
Sensitivity - 1 uV nominal (atmospheric noise limited)
Minimum Signal-Noise-Ratio (SNR)
Acquisition - -10 dB
Track - -30 dB
Position Display - -30 dB

1.3.2 LORAN-C ANTENNAS

1.3.2.1 A-16 WHIP ANTENNA with integral preamplifier (Standard)

1) Environmental Categories
   Temperature and Altitude - - - - - - - - - - D2
   Humidity - - - - - - - - - - - - - - - - - - A
   Vibration - - - - - - - - - - - - - - - - - - YJLM
   Electromagnetic Compatability - - - - - - - Z
2) Physical Characteristics
   Weight: 0.56 lbs (0.25 kg) Height: 17.75 in (45.09 cm)
3) Operational Characteristics
   Operating Temperature - -55°C to +70°C
   Operating Altitude - 50,000 feet (15,240 m)
   Speed - 350 kts (402 mph) TAS

1.3.2.2 A-17 BLADE ANTENNA with integral preamplifier (Optional)

1) Environmental Categories
   Temperature and Altitude - - - - - - - - - - D2
   Humidity - - - - - - - - - - - - - - - - - - A
   Vibration - - - - - - - - - - - - - - - - - - YJLM
   Electromagnetic Compatability - - - - - - - Z
2) Physical Characteristics
   Weight: 0.70 lbs (0.32 kg) Height: 8.2 in (20.83 cm)
3) Operational Characteristics
   Operating Temperature - -55°C to +70°C
   Operating Altitude - 50,000 feet (15,240 m)
   Speed - 521 kts (600 mph) TAS

1.3.2.3 A-23 BENT WHIP ANTENNA with integral preamplifier (Optional)

1) Environmental Categories
   Temperature and Altitude - - - - - - - - - D2
   Humidity - - - - - - - - - - - - - - - - - - A
   Vibration - - - - - - - - - - - - - - - - - - YJLM
   Salt Spray - - - - - - - - - - - - - - - - - S
   Electromagnetic Compatability - - - - - - - Z

2) Physical Characteristics
   Weight: 0.413 lbs (0.187 kg)
   Size: Height - 8.25 inches (20.96 cm)

3) Operational Characteristics
   Operating Temperature - -55°C to +70°C
   Operating Altitude - 50,000 feet (15,240 m)

4) Speed - 350 kts (402 mph) TAS

Due to II Morrow's commitment to constantly improve the quality and performance of our equipment, all specifications and features are subject to change without notice.

1.4 UNITS AND ACCESSORIES

1.4.1 Standard Units and Accessories Supplied

The APOLLO II Model 612A package consists of the APOLLO II Model 612A LORAN-C navigation receiver, the mounting frame, installation kit, and the choice of the A-16 Whip antenna, optional A-17 High Speed Blade antenna, or optional A-23 Bent Whip antenna. The A-16 Whip antenna is the standard antenna to accompany the APOLLO II Model 612A.

1.4.1.1 Units Supplied

II Morrow P/N	Description	Quantity
430-0132-001 and 430-0035-000	APOLLO II Model 612A A-16 Whip Antenna	1 1

1.4.1.2 Accessories Supplied

INSTALLATION KIT

II Morrow P/N	Description	Quantity
162-1008	Panel Plug Coax Delta	1
162-1009	BNC Connector Taper Grip Cable	1
162-3001	14-Pin Panel Receptacle	1
172-1501	Fuse - 5 Amp Fast Blow	1
201-0009	Pneumatic Fitting Sleeve	1
202-0001	Cable Tie	2
202-0005	Tie Mount	2
221-0304	3-48 x 1/4 Phillips Screws	2
221-0400	Screw with Lockwasher (4-40 x 1/4)	2
221-0406	Machine Screw (4-40 x 3/8)	2
229-0608	Button Head Hex Screw (6-32 x 1/2)	6
240-0310	#3 Internal Lockwashers	2
240-0410	#4 Internal Lockwashers	2
310-2030	Connector Cover	1
310-2032	Shoulder Bushing	2
418-0020	Mounting Frame Assembly	1
430-0131	FC-02 Low Level Flag Adapter	1
500-2024	Coaxial Cable 15 feet (RG58U Belden P/N 88240)	1
560-4001	612A Operation Manual Rev. 0, or later approved revision	1
560-9002	Binder 8-1/2" x 5-1/2" 3-Ring	1
561-0009	Aviation Warranty Card	1
560-4008	Model 612A IFR Installation Manual	1
565-1032	IFR Placard	1

1.4.2 ACCESSORIES

Antennas other than the ones supplied with an APOLLO LORAN-C receiver package may be purchased as an option by arrangement with the retailer or the factory. External annunciator packages are available from the factory or retailer and must be used in IFR installations.

1.4.2.1 ANNUNCIATORS

Appropriate Low Level Annunciator Lights (4) may be used for the external LORAN VFR, APPROACH, WAYPOINT ALERT and LORAN WARN Annunciators (see Figures 18, 19, & 20). External annunciators with these messages must be used in IFR installations. The LORAN VFR and LORAN WARN annunciators must have at least two lamps per annunciator in IFR installations. It is recommended, but not required, that the APPROACH annunciator have two lamps. The current draw for each external annunciator must not exceed 180 mA.

External annunciator panels are available from II Morrow Inc. in three physical configurations that provide annunciations of APPROACH, VFR WARN, WAYPOINT ALERT and LORAN WARN. See Figures 18, 19, and 20.

II Morrow P/N	Description
145-2100	LORAN Annunciator 2x2
145-2101	LORAN Annunciator 1x4 (Horizontal)
145-2102	LORAN Annunciator 4x1 (Vertical)

The LORAN annunciators available from II Morrow Inc. use two parallel lamps per annunciator. Use a T 1-3/4 bulb, midget flanged base lamp #387 (supplied) for 28 V installations or a #382 for 14 V installations.

1.4.2.2 ANTENNAS and PREAMPLIFIERS

Antennas optimized for use with APOLLO LORAN-C receivers are available from II Morrow Inc. For recommendations about special applications you should contact the factory. One of the following antennas are required for IFR installations.

430-0035-000	A-16 Whip Antenna with integral preamplifier
430-0038-000 or 430-0038-001	A-17 High Speed Blade Antenna with integral preamplifier
430-0066-000	A-23 Bent Whip Antenna with integral preamplifier

1.4.2.3 FC-02 LOW LEVEL FLAG ADAPTER

The FC-02 Low Level Flag Adapter is used to interface the APOLLO II with CDIs having separate movements for the TO/FROM flags and the NAV Flag.

430-0131-000	FC-02 Low Level Flag Adapter

1.5 FAA APPROVAL OF AREA NAVIGATION INSTALLATION

For compliance with certified installation of the APOLLO II Model 612A, all guidelines within AC-20-121, AC-43.13 Ch. 11 and this installation manual must be followed.

For IFR installations that have not been specifically approved for Non-precision Approach, the APOLLO II must be placarded stating "LORAN-C NOT APPROVED FOR APPROACH."

1.6 EQUIPMENT LIMITATIONS

1.6.1 APOLLO II LORAN-C Receiver

The APOLLO II receiver is limited to operating on all LORAN-C chains existing as of January 1986. In order for the APOLLO II to operate on chains and secondaries other than those specified in the table below, a software revision will be required.

TABLE OF LORAN-C CHAINS

GRI	NAME	SECONDARY DESIGNATOR	CODING DELAY
4990	CENTRAL PACIFIC		
		XRAY	11,000
		YANKEE	29,000
5930	CANADIAN EAST COAST		
		XRAY	11,000
		YANKEE	25,000
		ZULU	38,000
5970	COMMANDO LION (KOREA)		
		WHISKY	11,000
		XRAY	31,000
		ZULU	42,000
5990	CANADIAN WEST COAST		
		XRAY	11,000
		YANKEE	27,000
		ZULU	41,000
7170	SAUDI ARABIA (SOUTH)		
		WHISKY	11,000
		XRAY	26,000
		YANKEE	39,000
		ZULU	52,000
7930	LABRADOR SEA		
		WHISKY	11,000
		XRAY	26,000
7960	GULF OF ALASKA		
		XRAY	11,000
		YANKEE	26,000
7970	NORWEGIAN SEA		
		XRAY	11,000
		WHISKY	26,000
		YANKEE	46,000
		ZULU	60,000
7980	SOUTHEAST U.S.		
		WHISKY	11,000
		XRAY	22,000
		YANKEE	43,000
		ZULU	59,000

TABLE OF LORAN-C CHAINS (cont.)

GRI	NAME	SECONDARY DESIGNATOR	CODING DELAY
7990	MEDITERRANEAN	XRAY	11,000
		YANKEE	29,000
		ZULU	47,000
8940	WESTERN EUROPE (FRANCE)	WHISKY	12,000
		XRAY	30,000
8970	GREAT LAKES	WHISKY	11,000
		XRAY	28,000
		YANKEE	44,000
9940	WEST COAST	WHISKY	11,000
		XRAY	27,000
		YANKEE	40,000
9960	NORTHEAST U.S.	WHISKY	11,000
		XRAY	25,000
		YANKEE	39,000
		ZULU	54,000
9970	NORTHWEST PACIFIC	WHISKY	11,000
		XRAY	30,000
		YANKEE	55,000
		ZULU	75,000
9980	ICELANDIC	WHISKY	11,000
		XRAY	30,000
9990	NORTH PACIFIC	XRAY	11,000
		WHISKY	29,000
		ZULU	43,000

1.6.2 Acquisition
The APOLLO II will acquire and track the Master and all available Secondaries of a specified chain and operate as specified.

1.6.3 Maximum Track Velocity
The maximum track velocity is 600 knots at 0 dB SNR.

1.6.4 IFR Restriction

1) The APOLLO II is presently limited to IFR use in the following LORAN-C chains: 5990, 7980, 8970, 9940, and 9960.

2) The APOLLO II must be interfaced with a CDI display unit that has been previously FAA approved.

3) The APOLLO II must be used with external annunciators. These annunciators must be II Morrow P/N 145-2100, 145-2101, 145-2102, or equivalent. Equivalent external annunciator packages must have two lamps per annunciator for LORAN VFR and LORAN WARN.

4) The APOLLO II cannot be used for IFR flight when the LORAN VFR annunciator is lighted.

5) The APOLLO II must be installed with one of the following II Morrow antennas: A-16, A-17, or A-23.

6) The APOLLO II may not be used for IFR navigation during icing conditions.

7) The APOLLO II Model 612A shall not be used for conducting LORAN-C Non-precision Approaches without specific FAA approval.

1.7 RS-232 SERIAL DATA OUTPUT SPECIFICATIONS

The APOLLO II provides RS-232 serial data output for use in interfacing with computers possessing RS-232 data input capabilities. Data supplied will provide information on signal quality, position, and other displayed receiver functions. The specifications for the APOLLO Serial Data Output are described below.

Electrical Format:

RS-232C
Logic 1 = 0 Volts
Logic 0 = +5 Volts

Data Format:

Asynchronous, 1200 Baud
1 Start Bit
7 Data Bits
1 Parity Bit - Odd
1 Stop Bit

This data format conforms to Standard UART Data Format (INTEL 8251 and MOTOROLA MC6850).

The data is formatted into various groups representing receiver functions (i.e. Lat/Lon, SNR, and Signal Tracking status). Each data group is formatted by a control character followed by the data. Data is generally transmitted in ASCII format. A description of the data groups and their specifications is given below.

LATITUDE/LONGITUDE DATA GROUP

Character	Definition	Value
1	Start Character	'#'
2	Lat/Long Char.	'L'
3	Space	20H
4	Hemisphere	'N'
5	Lat. Deg. MSD	3_
6	Lat. Deg. LSD	3_
7	Lat. Min. MSD	3_
8	Lat. Min.	3_
9	Lat. Min.	3_
10	Lat. Min. LSD	3_
11	Space	20H
12	Hemisphere	'W'
13	Lon. Deg. MSD	3_
14	Lon. Deg.	3_
15	Lon. Deg. LSD	3_
16	Lon. Min. MSD	3_
17	Lon. Min.	3_
18	Lon. Min.	3_
19	Lon. Min. LSD	3_
20	<CR>	0DH

SNR VALUES DATA GROUP

Character	Definition	Value
1	Start Character	'#'
2	SNR Character	'S'
3	Space	20H
4	Master Identifier	'M'
5	Master SNR MSD	3_
6	Master SNR	3_
7	Master SNR LSD	3_
8	Space	20H
9	Slave Identifier	'A'
10	Slave SNR MSD	3_
11	Slave SNR	3_
12	Slave SNR LSD	3_
13	Space	20H
14	Slave Identifier	'B'
15	Slave SNR MSD	3_
16	Slave SNR	3_
17	Slave SNR LSD	3_
18	<CR>	0DH

NOTE: After the APOLLO II has settled, the 'A' and 'B' slave identifiers will be replaced by the appropriate letter for the station selected in the current triad (W, X, Y, or Z).

TRIAD SELECTION STATUS DATA GROUP

The bits denoting the stations (M,W,X,Y,Z) are set according to the tracking status of the selected triad. If the MWX triad is used, then only the M,W,X status bits are defined. A "0" bit value implies tracking status. A "1" bit value implies non-tracking status.

Character	Definition	Value
1	Start Character	'#'
2	Status Character	'C'
3	Space	20H
4	Status Word	(D7: 0 (D6: 0 (D5: 0 (D4: M (D3: W (D2: X (D1: Y (D0: Z
5	<CR>	0DH

NAVIGATION MODE VALUES DATA GROUP (A)

Character	Definition	Value
1	Start Character	'#'
2	Identifying Character	'N'
3	Identifying Character	'A'
4	Space	20H
5	Bearing Identifier	'B'
6	Bearing MSD	3_
7	Bearing	3_
8	Bearing LSD	3_
9	Space	20H
10	Range Identifier	'R'
11	Range MSD	3_
12	Range	3_
13	Range	3_
14	Range	3_
15	Decimal Point	'.'
16	Range LSD	3_
17	Space	20H
18	Bearing (FROM) Identifier	'B'
19	Bearing (FROM) Identifier	'F'
20	Bearing (FROM) MSD	3_
21	Bearing (FROM)	3_
22	Bearing (FROM) LSD	3_
23	Space	20H
24	Range (FROM) Identifier	'R'
25	Range (FROM) Identifier	'F'
26	Range (FROM) MSD	3_
27	Range (FROM)	3_
28	Range (FROM)	3_
29	Range (FROM)	3_
30	Decimal Point	'.'
31	Range (FROM) LSD	3_
32	<CR>	0DH

NAVIGATION MODE VALUES DATA GROUP (B)

Character	Definition	Value
1	Start Character	'#'
2	Identifying Character	'N'
3	Identifying Character	'B'
4	Space	20H
5	DTK Identifier	'C'
6	DTK MSD	3_
7	DTK	3_
8	DTK LSD	3_
9	Space	20H
10	Distance Identifier	'D'
11	Distance MSD	3_
12	Distance	3_
13	Distance	3_
14	Distance	3_
15	Decimal Point	'.'
16	Distance	3_
17	<CR>	0DH

NAVIGATION MODE VALUES DATA GROUP (C)

Character	Definition		Value
1	Start Character		'#'
2	Identifying Character		'N'
3	Identifying Character		'C'
4	Space		20H
5	TRK Identifier		'T'
6	TRK	MSD	3_
7	TRK		3_
8	TRK	LSD	3_
9	Space		20H
10	GS Identifier		'S'
11	GS	MSD	3_
12	GS		3_
13	GS		3_
14	Decimal Point		'.'
15	GS	LSD	3_
16	Space		20H
17	ETE Identifier		'E'
18	ETE Identifier		'T'
19	ETE	MSD	3_
20	Colon		':'
21	ETE		3_
22	ETE	LSD	3_
23	Space		20H
24	XTD Identifier		'X'
25	XTD Identifier		'T'
26	XTD Sign		'+' or '-'
27	XTD	MSD	3_
28	XTD		3_
29	Decimal Point		'.'
30	XTD		3_
31	XTD	LSD	3_
32	<CR>		0DH

NOTE: When Ground Speed is less then 1.0 knot, the TRK and ETE digits will be replaced by dashes ('-') and the Ground Speed digits will be all zeros.

SECTION II
INSTALLATION PROCEDURES

2.1 GENERAL INFORMATION

This section presents installation and wiring information for the APOLLO II LORAN-C Navigation Receiver and antenna system.

2.1.1 Standard Practices

At all times, installation procedures should follow good aviation installation practices as per AC 43.13 Ch. 11 and AC 20-121.

2.1.2 Installation Limitations

1) The antenna placement is possible on both the top or bottom of the aircraft. Preferred placement for best performance is top mounting. If bottom mounted, see sec. 2.3.2

2) The LORAN-C antenna must be at least 6 inches from a transmitting antenna that emits 25 W or less, and at least 2 feet away from a high power radio transmitting antenna.

3) The antenna must be of a type approved by II Morrow Inc. The list below indicates the currently approved antennas for IFR certification with the APOLLO II Model 612A.

Whip:	~~A-16~~	P/N 430-0035-000	(Standard)
Bent Whip:	A-23	P/N 430-0066-000	(Optional)
Blade:	A-17	P/N 430-0038-000 or 430-0038-001	(Optional)

4) In selecting an antenna mounting site, consider locations that meet the following criteria: low electrical noise, unobstructed reception, proper grounding to the aircraft frame, and adequate metal surface area for a good ground plane (this may need to be added by the installer).

5) A CDI or HSI display unit connected to the APOLLO II Model 612A must be one that has been previously FAA approved. Units such as a Sperry IN385A, RD650A, IN480, King KI525A, Aeronetics 9137, Collins IND350A, or equivalent may be used. Units with internal conversions may not be used. CDIs that have separate movements for the TO/FROM and the NAV VALID flags (such as the Collins IND350A) must use the FC-02 Low Level Flag Adapter P/N 430-0131-000.

6) Circuit breakers or fuses shall not exceed a maximum current rating of 5.0 Amperes. Fuses, when used, shall be of the slow-blow type. Circuit breakers, when used, shall be resettable. Circuit breakers should meet MIL STD MS-25244-5, MS-22073-5, or MS-26574 (such as Klixon MS-26754-5, OR 7274-2-5).

7) Switches should meet MIL-1-45208A. Relays should meet MIL-STD-202B.

2.1.3 Static Precautions

LORAN-C installations are sensitive to precipitation static. Precipitation static may cause interference, or even loss of the signal, in severe weather conditions (dust, ice, rain, or snow). Engine exhaust may also cause precipitation static.

Special attention is required to protect the aircraft from precipitation static when navigation in inclement weather is expected.

The fuselage of the aircraft should have ground bonding straps between all sections and control surfaces to provide a common ground throughout the aircraft. All equipment should be well grounded to the aircraft frame. De-icing boots and doors should be bonded to the airframe. When making ground connections, use fine sandpaper to remove all paint and protective coatings. Use appropriate compounds for surface preparation and finishing of grounding points. Locate the antenna as far to the rear as possible on the aircraft.

Install static discharge wicks in the appropriate locations and according to the manufacturer's specifications. Be careful to insure that the wicks are well bonded and have them periodically inspected for damage. Use a good quality static discharge wick. Frayed tip wicks are not recommended.

The windshield of an aircraft often provides an additional source of electrical interference caused by frictional charging. Bonding the windshield to the airframe will reduce this source of interference.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Exercise care when unpacking the equipment. Visually inspect the unit for any evidence of damage incurred during shipment. It is advised to retain the shipping container and packaging material in case reshipment becomes necessary.

> NOTE: If a claim of damage needs to filed, save the shipping container to substantiate the claim. The claim should be appropriately filed with the shipping company.

2.3 EQUIPMENT INSTALLATION

This section will detail the installation of the antenna, receiver, preamplifier, indicators, and wiring hookups. Read the entire section before beginning the installation process. Perform the system checkout procedure before sealing the work area in case problems occur. Additional information is provided on bottom mounting an antenna, air cooling, and helicopter installation.

2.3.1 Antenna Installation

II Morrow offers several antenna configurations for use with APOLLO II units. Antennas produced by II Morrow Inc. are optimized for use with the APOLLO LORAN-C receivers.

Antennas for the APOLLO II may either be top or bottom mounted. Top mounting is the recommended position, however if bottom mounting is required instructions are provided for the necessary internal adjustments in the APOLLO II (see section 2.3.2).

Proper grounding is one of the most important factors in LORAN-C antenna installation. Optimum grounding and antenna performance may be obtained with direct metal-to-metal contact between the antenna base and aircraft skin (or installed ground plane). Paint should be removed beneath the antenna base and the surface should be lightly sanded. In some cases, a heavy gauge wire between the antenna base and the aircraft may be required.

Optimum antenna performance requires an adequate metal surface below the antenna mount to create a ground plane. If the selected antenna position does not provide a sufficient ground plane, the installer will need to create one by using a wire mesh, wire radials, or metal plating. The ground plane, installed or otherwise, must be connected to the aircraft chassis ground.

II Morrow Inc. LORAN-C antennas are vertically polarized with the preamplifier internally mounted. The antennas are connected directly to the APOLLO II. The connecting cable should be RG58A/U or RG58/U. The length is not critical (length should not exceed 100 ft).

The A-16 whip antenna is the standard antenna with the APOLLO II. The maximum recommended speed for the A-16 whip antenna is 350 knots (402 mph) TAS.

The A-17 blade antenna is an optional antenna with the APOLLO II. The maximum recommended speed for the A-17 blade antenna P/N 430-0038-000 is 521 knots (600 mph) TAS. The maximum recommended speed for the A-17 blade antenna P/N 430-0038-001 is 600 knots (690 mph or 0.9 mach) TAS.

The A-23 bent whip antenna is an optional antenna with the APOLLO II. The maximum recommended speed for the A-23 bent whip antenna is 350 knots (402 mph) TAS.

Never wax or paint an antenna. Coating an antenna with a foreign substance may severely reduce the received signal. Some paints may not be removed without destroying the P-Static coating of the antenna.

2.3.2 Bottom Mounted Antenna Placement

While the best location for antenna installation is on the top of the aircraft, it is possible to mount the antenna on the bottom. Phase reversal of the LORAN-C signal occurs when the antenna is bottom mounted. The APOLLO II has an internal jumper wire connection on the Digital Board to correct for this condition. The diagram below shows the position of the jumper connection (see Figure 3). The jumper should be in the "+" position for a top mounted antenna and should be in the "-" position for a bottom mounted antenna. The APOLLO II comes from the factory with the jumper in the "+" position.

The Digital Board is located beneath the top cover of the APOLLO II. Access is gained by removing the five phillips screws attaching the top cover, two on each side and one on the rear. Connector J7 is located in the front right corner of the Digital Board as you are facing the front of the unit.

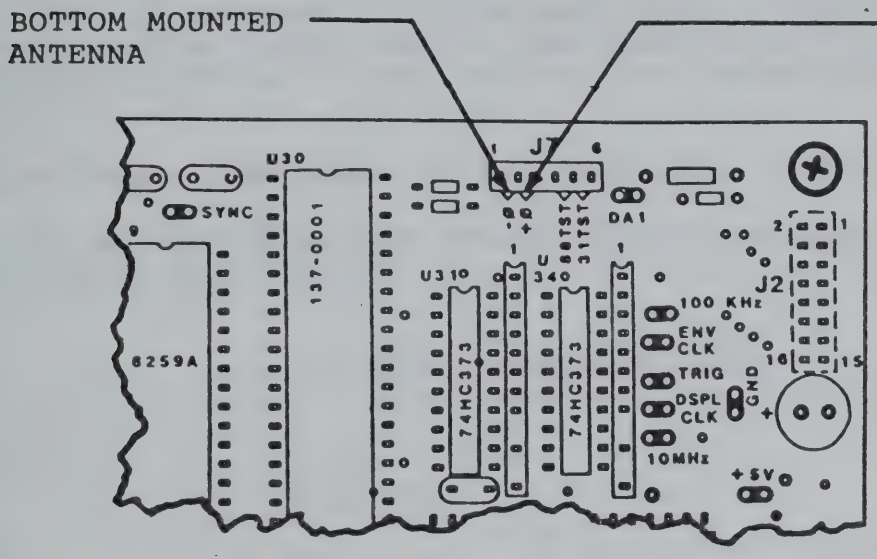


Figure 3

WHIP ANTENNA

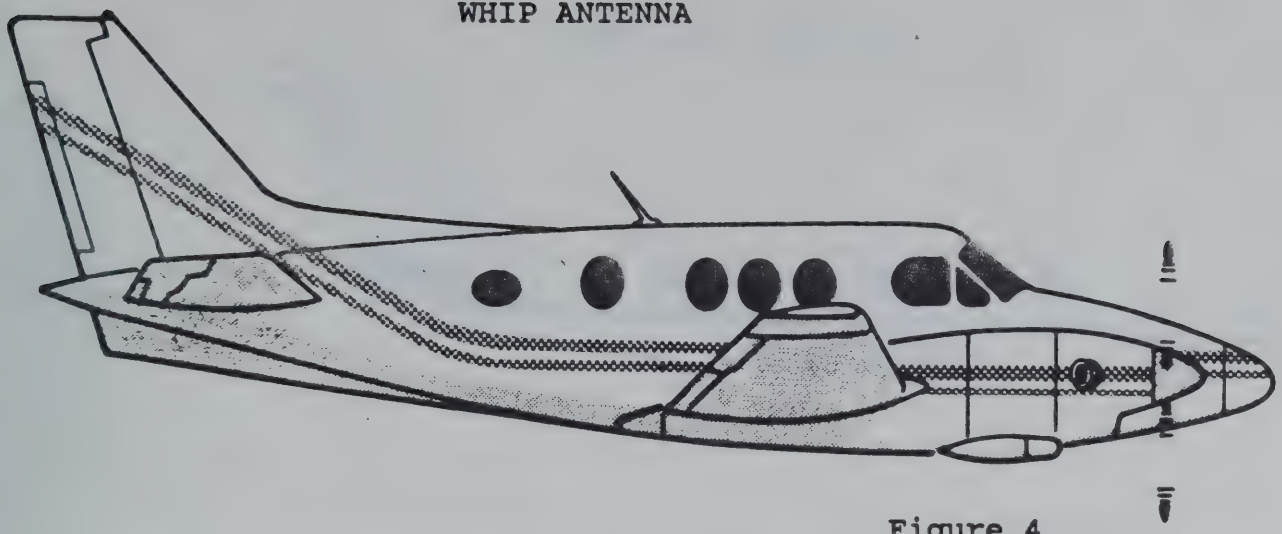


Figure 4

Locate the A-16 at least 6 inches away from a transmitting antenna that emits 25 W or less, and two feet away from a high power transmitting antenna. Do not use the A-6 preamplifier with the A-16 antenna.

No whip antenna other than the A-16 may used in IFR installations.

NOTE: The antenna should be placed as high as possible for optimum performance.

A-16 WHIP ANTENNA and MOUNT

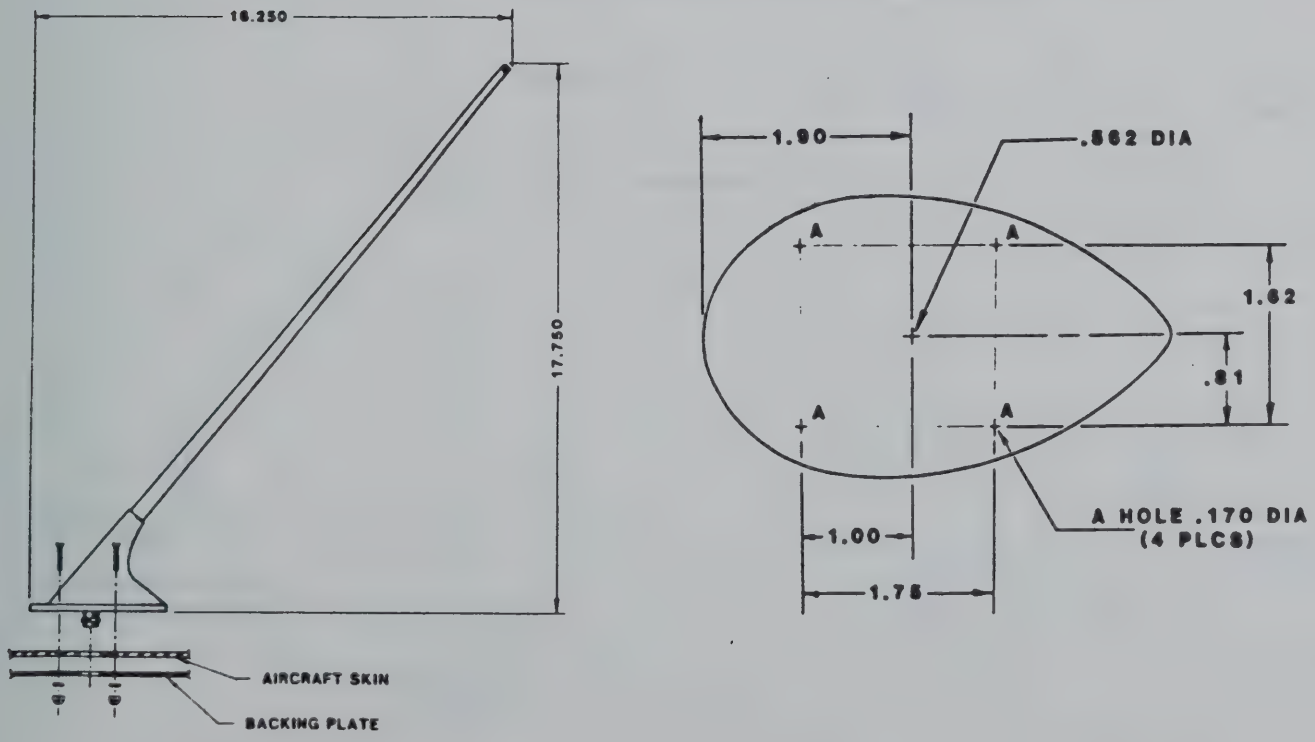


Figure 5

BENT WHIP ANTENNA

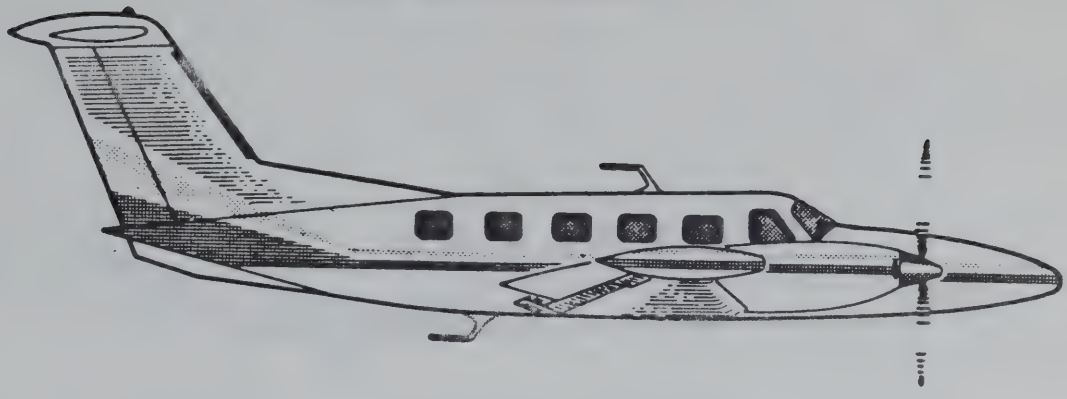


Figure 6

Locate the A-23 at least 6 inches away from a transmitting antenna that emits 25 W or less, and two feet away from a high power transmitting antenna. Do not use the A-6 preamplifier with the A-23 antenna.

No bent whip antennas other than the A-23 may be used in IFR installations.

NOTE: The antenna should be placed as high as possible for optimum performance.

A-23 WHIP ANTENNA and MOUNT

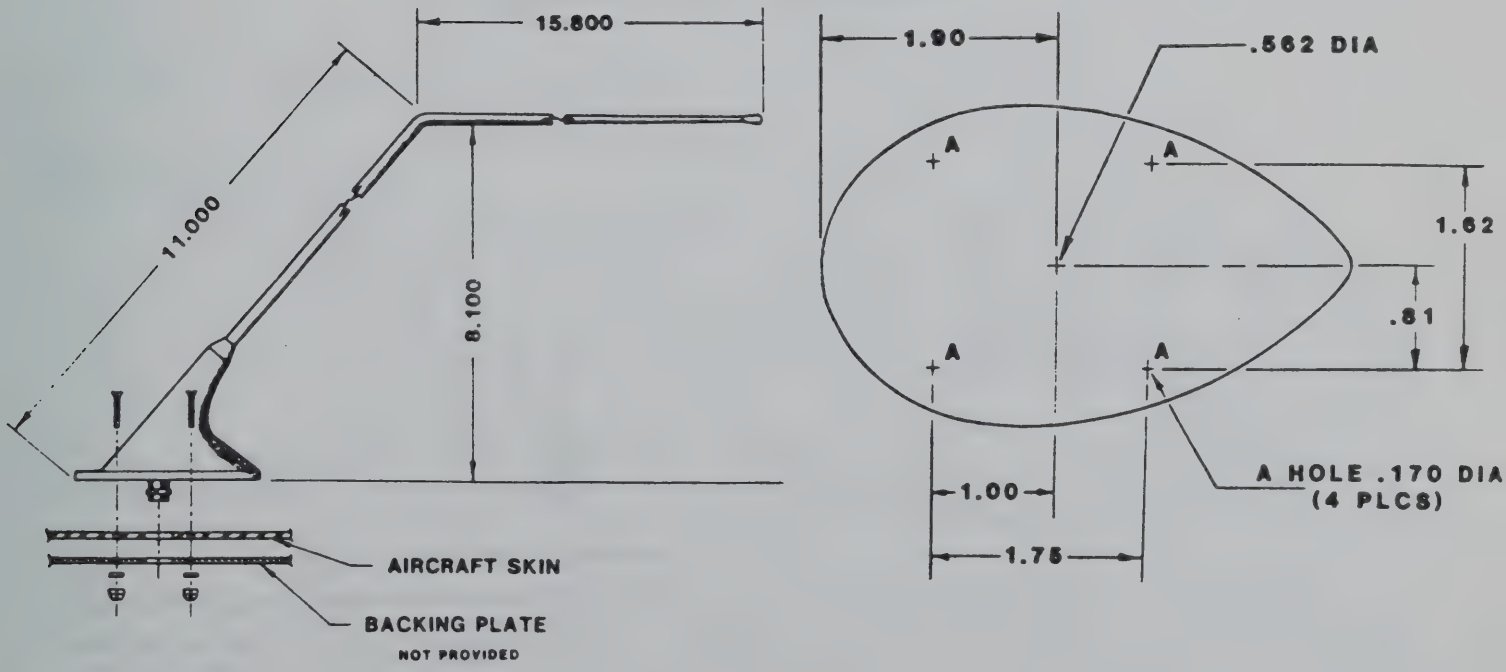


Figure 7

BLADE ANTENNA

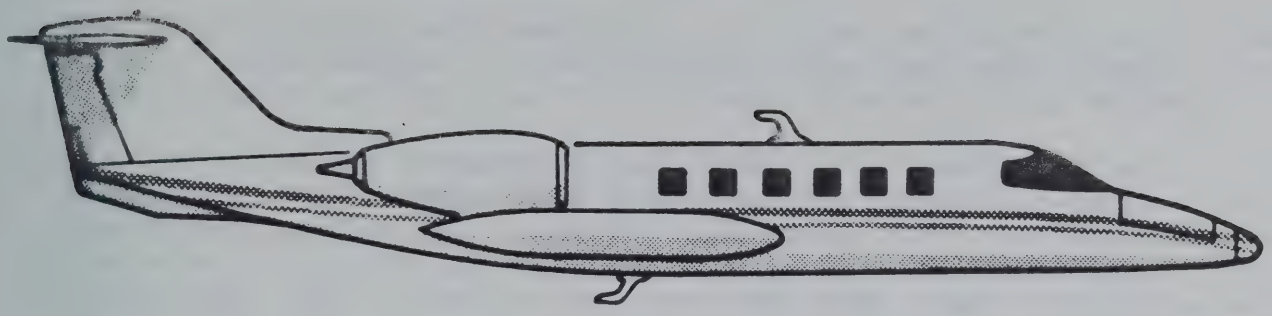


Figure 8

Locate the A-17 at least 6 inches away from a transmitting antenna that emits 25 W or less, and at least two feet away from a high power transmitting antenna. Do not use the A-6 preamplifier with the A-17 antenna. The supplied coax cable which connects between the APOLLO LORAN-C receiver and the antenna may be changed in length.

No other blade antenna may be used with the APOLLO LORAN-C receiver in IFR installations

NOTE: The antenna should be placed as clear as possible from obstructions for optimum performance. Bottom mounting is permitted (see section 2.3.2).

A-17 BLADE ANTENNA and MOUNT

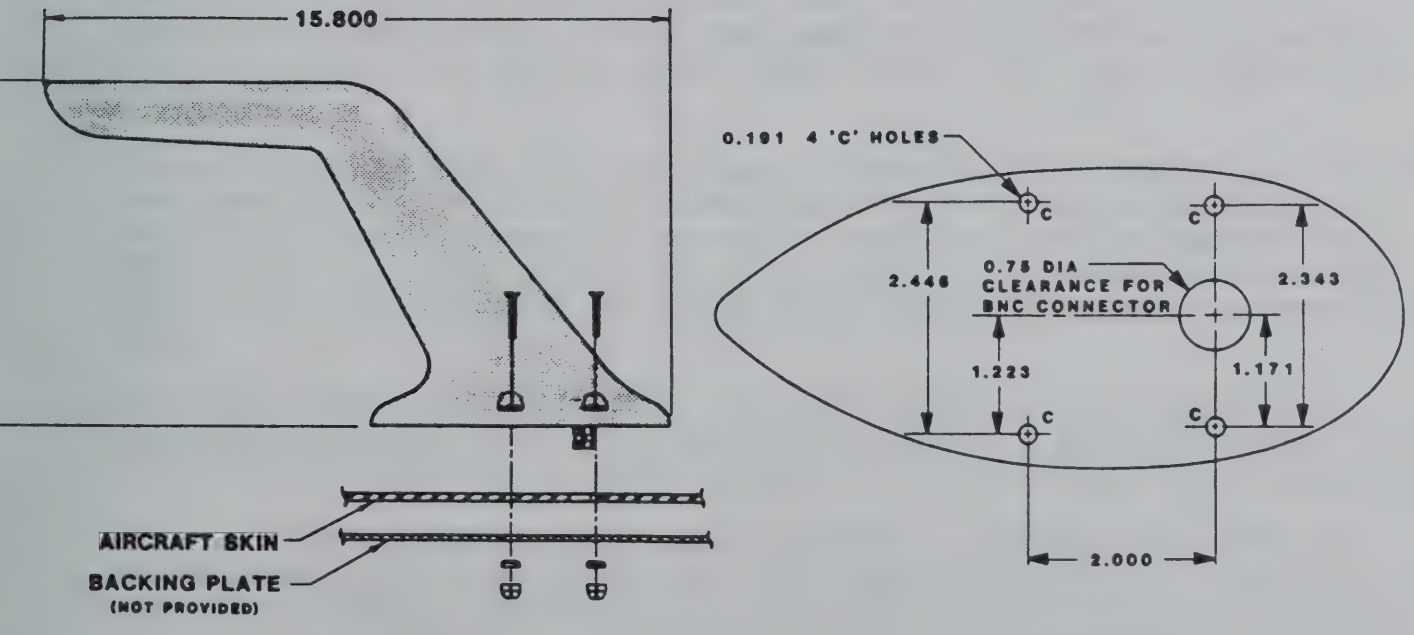


Figure 9

2.3.3 APOLLO II Receiver Installation

The APOLLO II LORAN-C Receiver is designed to be panel mounted with the enclosed accessories and hardware. The APOLLO II is best located in a position where the pilot has a clear view of the display during instrument scans.

The APOLLO II is very sensitive and uses relatively low signal levels. The APOLLO II should not be located near motors, or any other item which creates high levels of electrical noise.

The installation procedure described is illustrated with several diagrams. The recommended installation procedure begins with the determination of required clearances for the receiver in the panel. Figure 21 combines a view of the front panel with dimensions and a view of the top and side views with dimensions. The depth of the receiver from the front panel to the rear connectors is 11.2 inches (28.45 cm). Allow adequate depth in the mounting area to prevent sharp bends in any cable or wire. Leave a clearance of 1/4" between all components of the avionics stack for cooling, if possible. See section 2.3.6 on air cooling.

A diagram (Figure 22) of the Installation Assembly for the mounting frame illustrates the electrical and mechanical connections to the unit.

Install the mounting frame into the panel when the mounting frame connections are completed. Carefully insert the APOLLO II into the mounting frame, noting that the pin connectors match. Thread the slotted screw into the receiver and tighten the screw to securely lock the receiver into the panel.

2.3.4 Wiring Instructions

Determine the length and routing of all cables before actual installation. When installing cables, avoid any sharp bends or placement near the aircraft control, power, DME, transponder, or radio communications cables. Wire must meet MIL-W-22759 or MIL-W-5086. PVC insulated wire may be used, but Tefzel or Teflon insulated is preferred.

The wiring necessary for the installation of the APOLLO II includes the rear panel electrical connections and antenna/preamplifier cable placement. Preparation of the antenna and/or preamplifier cables is also necessary. The panel receptacle must be assembled and may be wired before or after being installed into the mounting frame.

A wiring diagram (Figure 23) shows the electrical connections. The recommended connecting wire size is 20 AWG. A pin assignment list is shown in Figure 28. Panel receptacle wiring is shown in Figure 22.

Measure the length of coax cable needed to connect the antenna (with integral preamplifier) to the receiver unit. 15 feet of coax cable (RG58U II Morrow P/N 500-2024) are provided. Begin to prepare the required length of coax cable as described by "Cable Preparation and Assembly" after determining necessary routing.

Prepare the coax cable for the panel plug fitting as described in "Cable Preparation and Assembly for Panel Plug Connector P/N 162-1008". Assemble the panel plug as detailed in Figure 17. Secure the assembled panel plug to the mounting frame (See Figure 19). The panel plug connection is kept as a floating connection through the shoulder bushings. The connection will adjust itself once the receiver is inserted into the mounting frame. Run the coax cable to the antenna preamplifier and secure the BNC connector.

2.3.4.1 Cable Preparation and Assembly for BNC Connector P/N 162-1009

1) Cut the cable end square. Remove jacket, braid, and cut dielectric 1/4". Cut cable jacket back only an additional 1/32". Be careful not to nick the braid. Flare the braid to accept the cone. Slit the jacket 1/4" in 2 places 180° apart. Tin the center conductor.

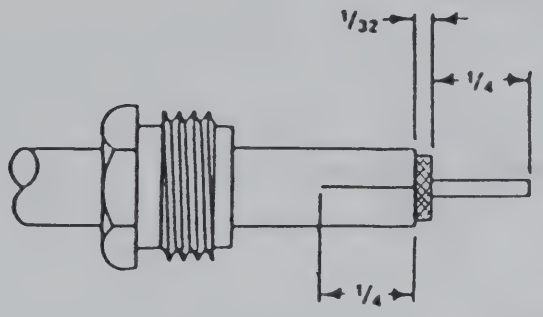


Figure 12

2) Slide the cone assembly under the braid until it touches the shoulder. Soft solder the contact to the center conductor.

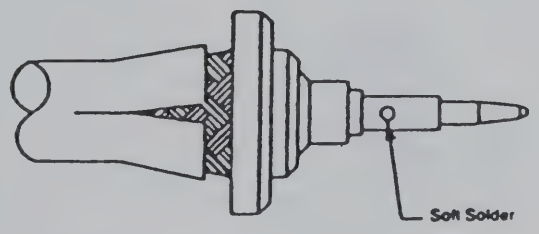
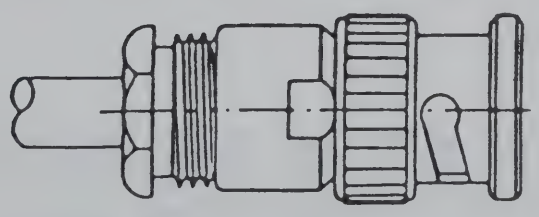


Figure 13

3) Slide the clamp nut over the flared portion of the cable. Thread the connector body onto the nut while holding the nut stationary. Tighten securely.



Attach to Preamplifier or Antenna

Figure 14

2.3.4.2 Cable Preparation and Assembly for Panel Plug Connector P/N 162-1008

1) Cut the cable end square. Remove jacket, braid, and cut dielectric 1/4". Cut cable jacket back only an additional 1/32". Be careful not to nick the braid. Flare the braid to accept the cone. Slit the jacket 1/4" in 2 places 180° apart. Tin the center conductor.

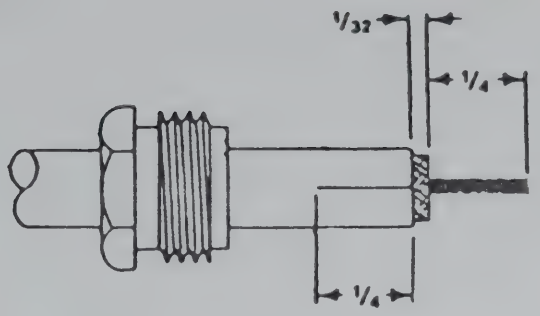


Figure 15

2) Slide the cone assembly under the braid until it touches the shoulder. Soft solder the contact to the center conductor.

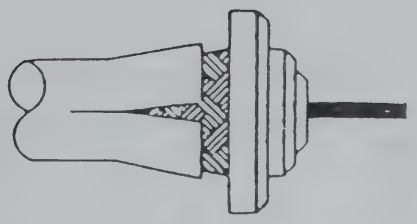
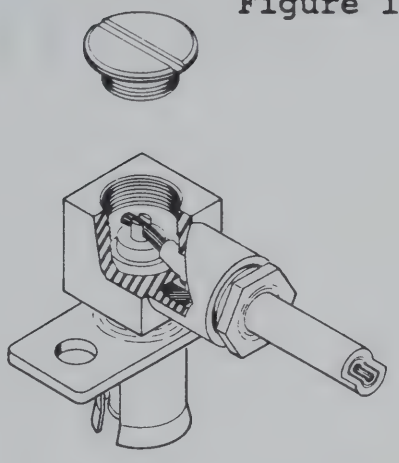


Figure 16

3) Slide the clamp nut over the flared portion of the cable. Thread the connector body onto the nut while holding the nut stationary. Tighten securely.



Attach to Back Panel of Mounting Frame.

Figure 17

2.3.5 ANNUNCIATORS

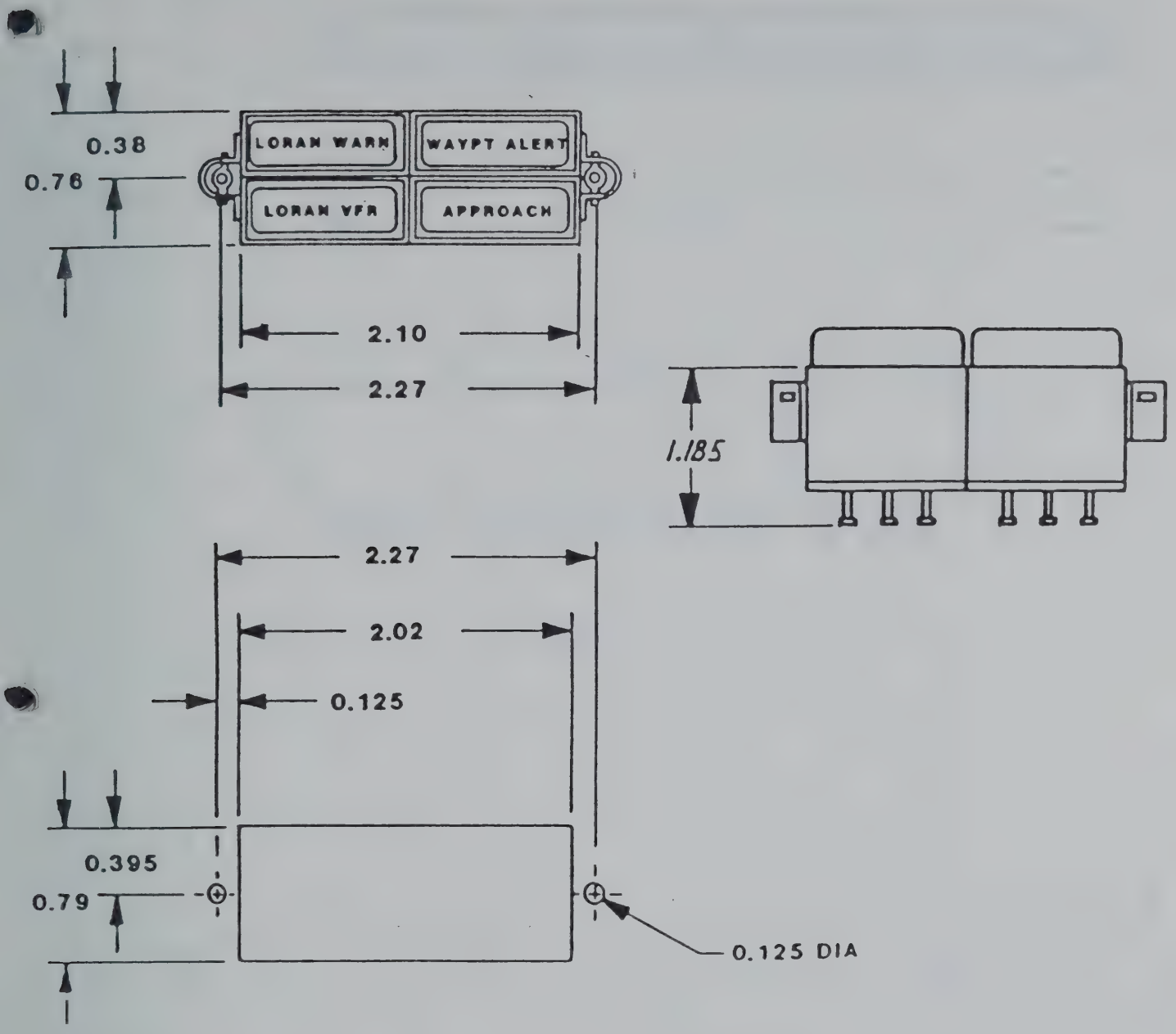
External LORAN VFR, APPROACH, WAYPOINT ALERT and LORAN WARN annunciators must be connected to the APOLLO II in IFR installations. The annunciator connections are shown on the wiring diagram in Figure 23. The APOLLO II output operates as a grounding switch. Annunciators available from II Morrow, Inc. are shown in Figures 18, 19, and 20.

CAUTION: Do NOT apply 12 or 28 VDC directly to pins 1 and 3 of the back panel connector. If you choose not to connect the annunciators, leave the pins unconnected. The maximum sink current, or current that can be shorted to ground, is 180 mA for each annunciator or relay (see Figures 23 and 24).

Mount the external annunciators in a location that is in full view of the pilot. Use the measurements of Figures 18, 19, or 20 to drill the mounting holes and to cut the panel for annunciator placement.

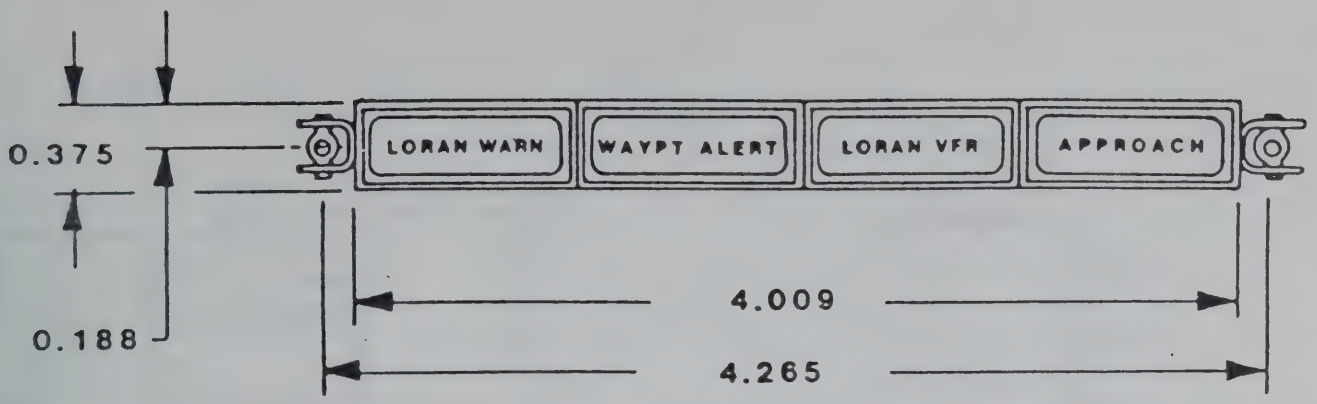
LORAN-C EXTERNAL ANNUNCIATOR PANEL

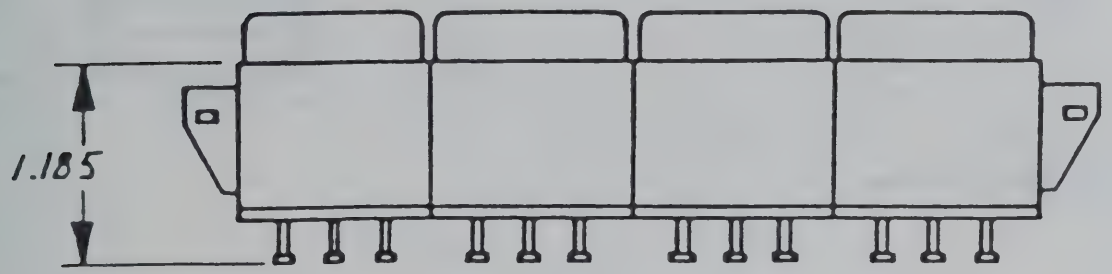
II MORROW, INC. P/N 145-2100

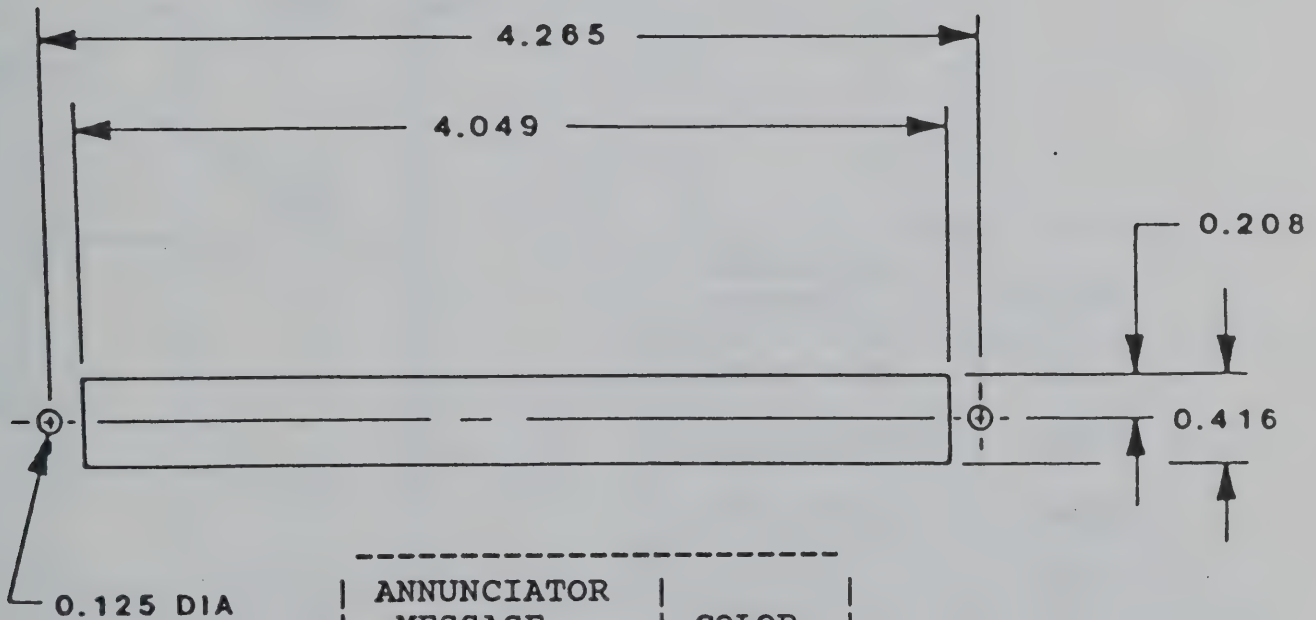


ANNUNCIATOR MESSAGE	COLOR
LORAN WARN	RED
WAYPT ALERT	AMBER
LORAN VFR	AMBER
APPROACH	AMBER

Figure 18

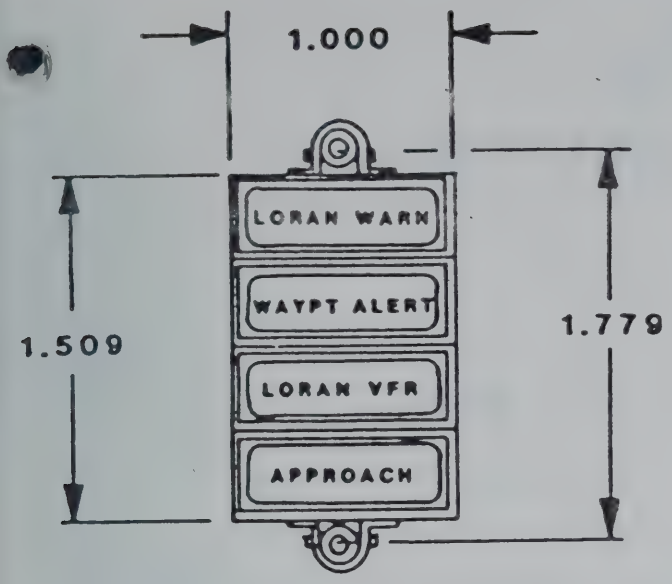


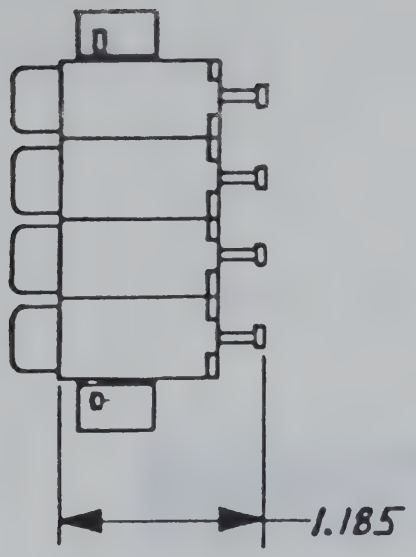


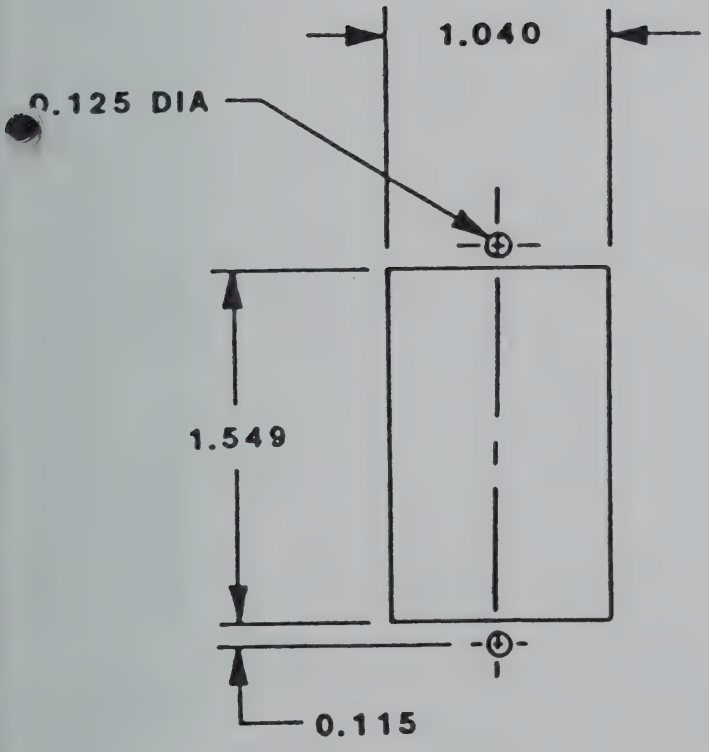


ANNUNCIATOR MESSAGE	COLOR
LORAN WARN	RED
WAYPT ALERT	AMBER
LORAN VFR	AMBER
APPROACH	AMBER

Figure 19







ANNUNCIATOR MESSAGE	COLOR
LORAN WARN	RED
WAYPT ALERT	AMBER
LORAN VFR	AMBER
APPROACH	AMBER

Figure 20

Apollo II

FRONT PANEL, TOP, and SIDE VIEWS

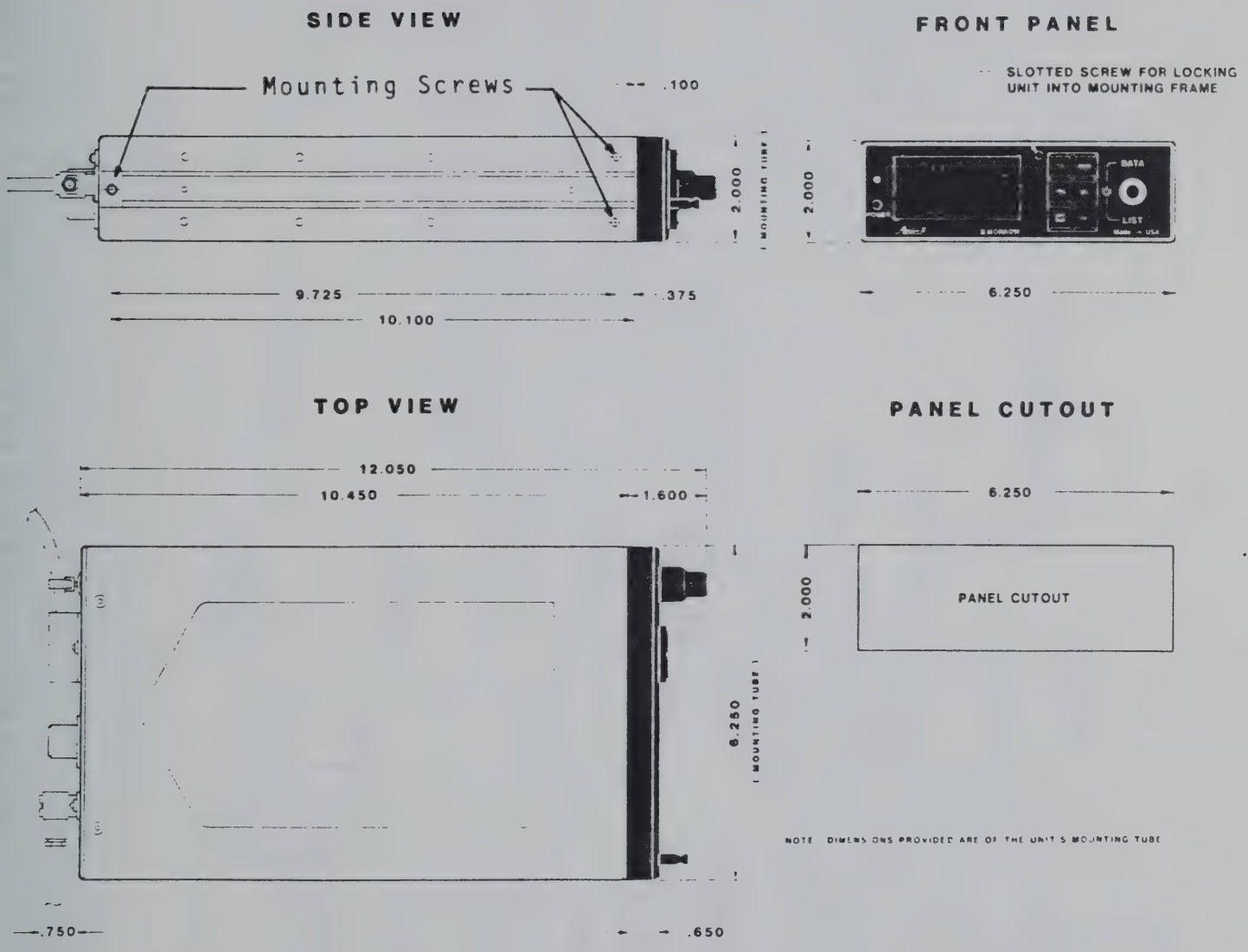


Figure 21

APOLLO II Model 612A Installation Assembly

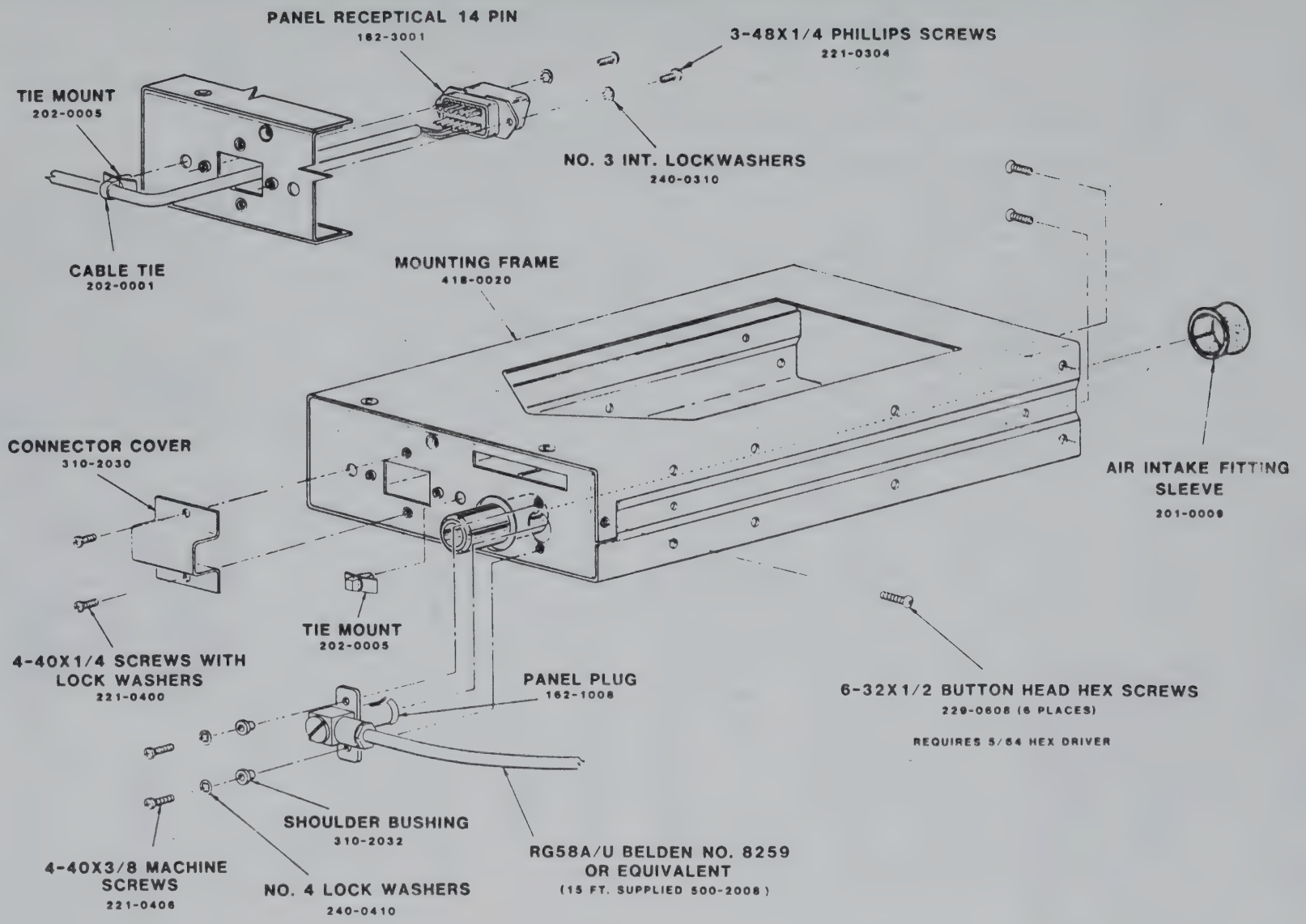


Figure 22

INSTALLATION WIRING DIAGRAM FOR THE APOLLO II MODEL 612A

See Figures 18, 19, and 20
for external annunciator packages.

Optional Dimmer Circuit

Use a 1N2980 16V 10W Zener Diode for 28V installations or a 1N2970 6.8V 10W Zener Diode for 14V installations. Use a heat sink with the zener.

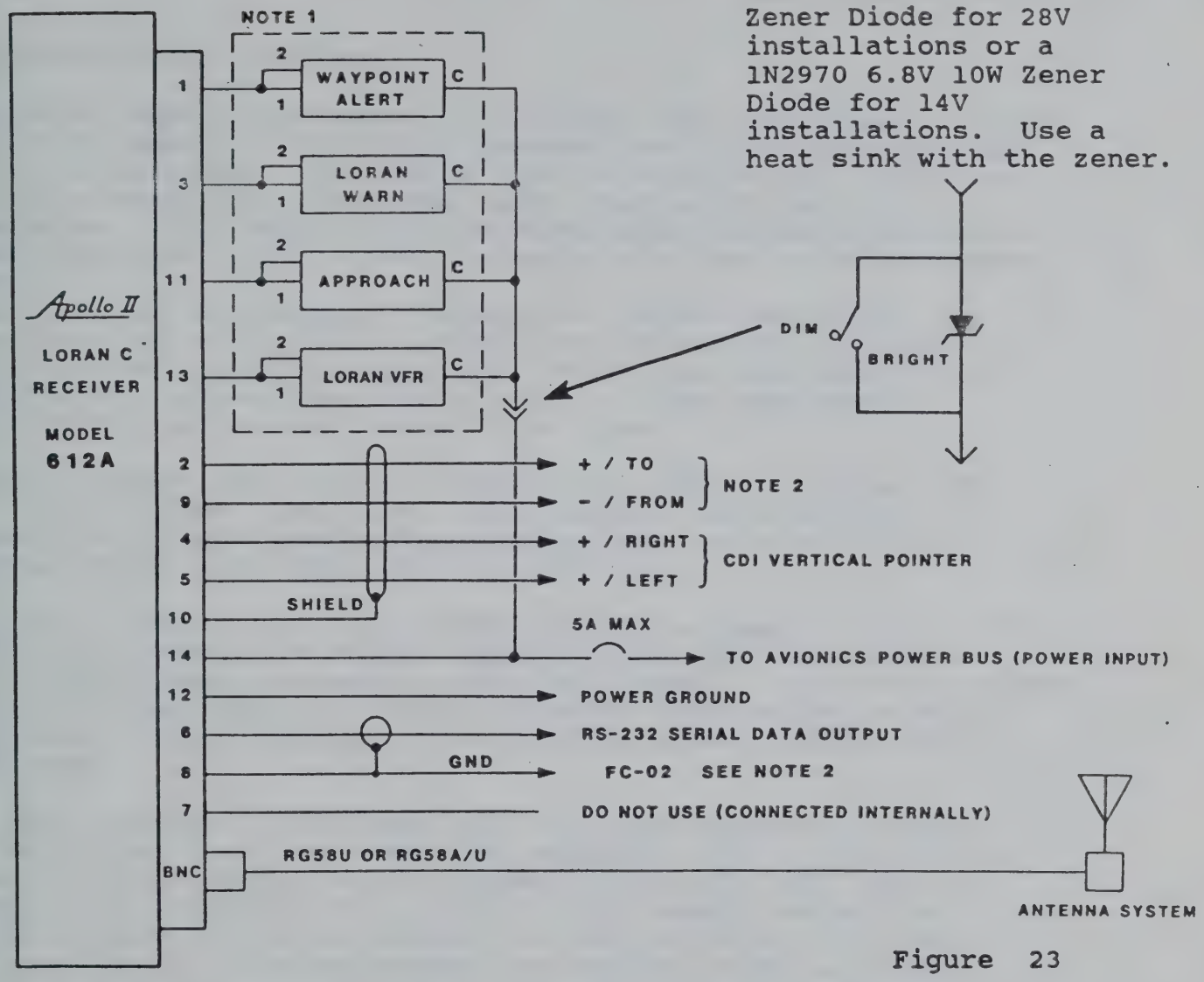


Figure 23

NOTE 1: Use 12 or 28 Volt indicator lamps or relays depending on the supply voltage. Lamps or relays MUST NOT draw more than 180 mA each. If a relay is used, a diode must be placed across the relay as shown. A relay meeting MIL-STD-202B is approved. An example is: Potter & Brumfield R 10-E1-V430 24VDC 6PDT (24 V application).

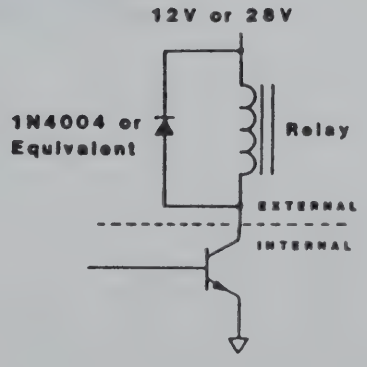


Figure 24

NOTE 2: Due to the diversity of CDI movements available the following notes on CDI/AUTOPILOT/HSI Interface may be used to guide the installer for the application necessary. A CDI or HSI must be used in IFR installations. CDIs that have separate TO/FROM and NAV VALID FLAG movements require the use of the FC-02 Low Level Flag Adapter.

CDI/AUTOPILOT/HSI INTERFACE

The APOLLO LORAN-C receiver will interface with low level (±150 uA) CDI and HSI meters. The wiring diagram shown above indicates the pins to be connected. The APOLLO LORAN-C receiver CDI interface will not operate with units that have internal CDI or HSI conversions. CDIs with 200 ohm TO/FROM meter movements require a 750 ohm resistor (1/8 or 1/4W) in series with the TO/FROM movement.

HSI systems may be connected in parallel to the Left/Right connections (Pins 4 and 5). Autopilots may then be connected to the appropriate outputs of the HSI. Follow the Autopilot or HSI manufacturer's directions. Up to four 1 K ohm loads may be connected between the LEFT/RIGHT (5,4) pins.

The only proper flags that will appear for LORAN-C information are: "OFF", "FROM", and "TO". When using a CDI that has a 200 ohm/250 mV meter movement specification, the APOLLO LORAN-C receiver output will drive only one NAV flag.

CDIs with a single integral TO/FROM and OFF movement: Pin 2 (+TO) of the 14-pin connector should connect to the CDI "+TO" and Pin 9 (-FROM) should connect to the CDI "+FROM". The "TO" or "FROM" flag will appear whenever LORAN-C steering information is valid. Up to four 1 K ohm loads may be connected between the TO/FROM (2,9) pins.

CDIs with separate TO/FROM and NAV VALID FLAG movements require the use of the FC-02 Low Level Flag Adapter. Pin 2 (+TO) of the APOLLO 14-pin connector should connect to the CDI "+TO" and to the BLUE wire of the FC-02. Pin 9 (-FROM) should connect to the CDI "-FROM" and to the ORANGE wire of the FC-02. The YELLOW wire from the FC-02 should connect to the CDI "-NAV" and the GREEN wire should connect to the CDI "+NAV" input. See figures 25 and 26 for connection examples. Only one CDI NAV VALID flag may be driven in this configuration.

APOLLO II TO CDI/HSI INTERFACE DIAGRAMS

LORAN/CDI INTERCONNECTION

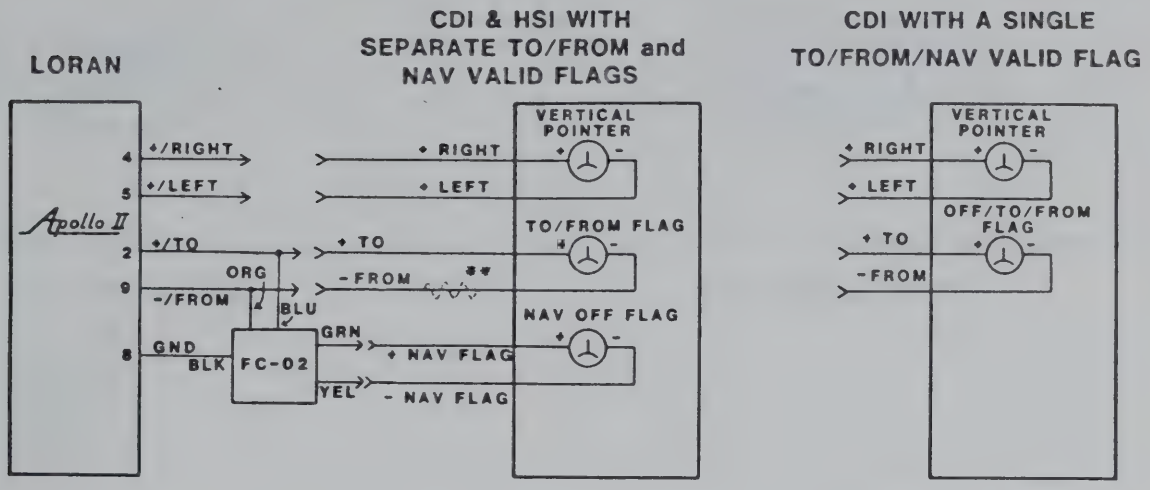
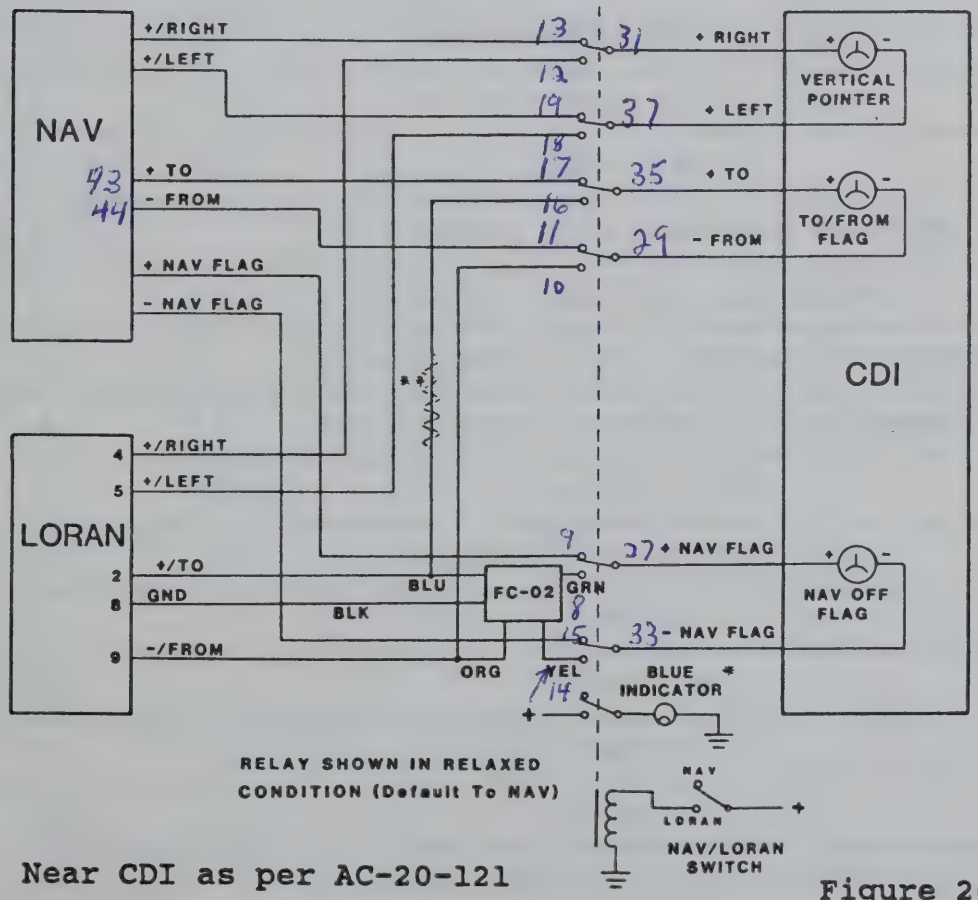


Figure 25

LORAN/NAV/CDI INTERCONNECTION

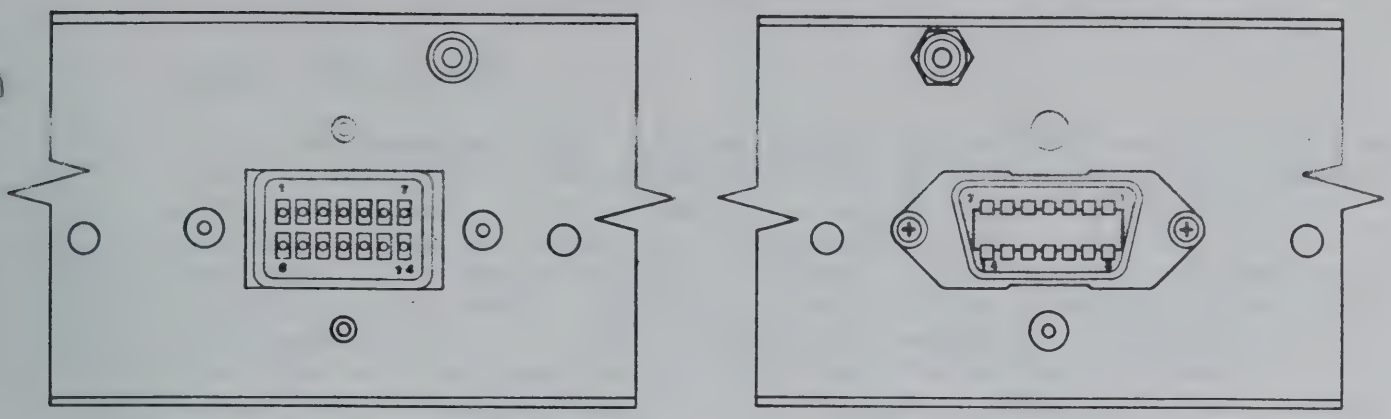


* Near CDI as per AC-20-121

Figure 26

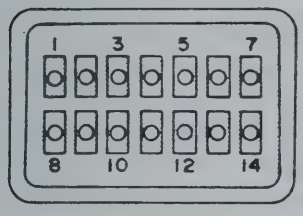
** 200 ohm meter movements require a 750 ohm resistor in series with the TO/FROM movement.

MOUNTING FRAME CONNECTOR PANEL
(REAR VIEW)



VIEW FROM REAR

VIEW FROM INSIDE



CONNECTOR PINOUT

Figure 27

REAR CONNECTOR PIN ASSIGNMENT

PIN NUMBER	FUNCTION
1	WAYPOINT ALERT (ARRIVE)
2	+ (TO) (NAV VALID FLAG)
3	LORAN-C WARN
4	+ (RIGHT) (CDI VERTICAL POINTER)
5	+ (LEFT) (CDI VERTICAL POINTER)
6	RS-232 SERIAL DATA OUTPUT INTERFACE
7	DO NOT USE (INTERNALLY CONNECTED)
8	RS-232 GROUND
9	- (FROM) (NAV VALID FLAG)
10	SHIELD
11	APPROACH
12	GROUND
13	LORAN VFR
14	A+ POWER INPUT (12 VDC or 28 VDC)

Figure 28

2.3.6 AIR COOLING

It is recommended, but not required, to use air cooling such as ram air or a fan to enhance the life of the electronic components within avionics. Since heat is a major enemy of electronic equipment, the reliability and longevity of avionics will be increased with any reduction in heat. The removal of heat by air circulation between avionics units will be enhanced by separating components by 1/4". As a protective measure, the APOLLO II displays will automatically dim when the avionics stack temperature reaches too high of a level. This will be avoided if a cooling system is used.

The APOLLO II has an air cooling input for connection by tubing to either ram air or a fan to allow cooling to the unit. The cooling air is brought to the unit by 5/8" tubing. Connection is made by pressing the tubing over the exposed air connector. On the top right side at the rear of the unit an air exhaust port is provided to allow the cooling air to exit. Do NOT cover this opening.

It is recommended to use a method which will produce the best cooling efficiency. Follow all of the manufacturer's installation directions carefully and use good aviation installation practices. If a ram air system is used it should be a type that is water-free and filtered.

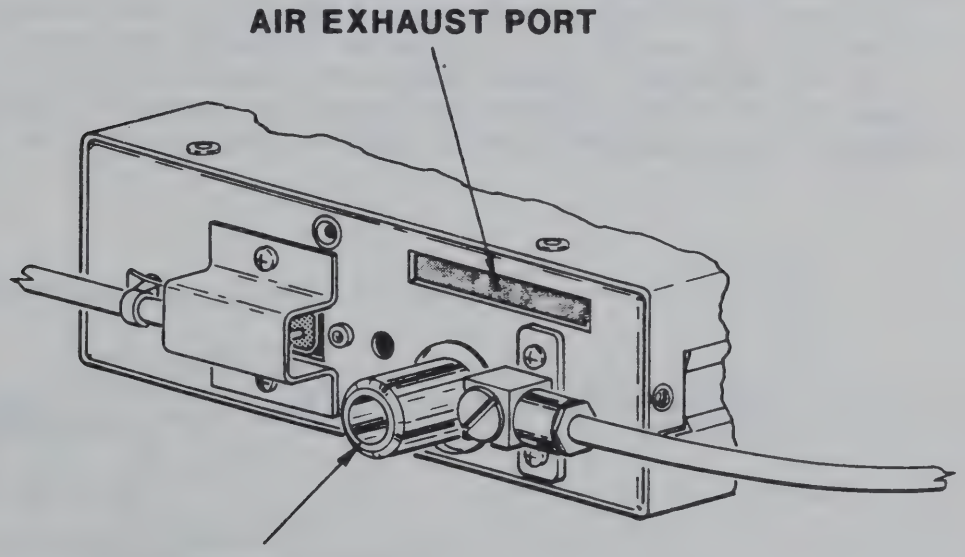


Figure 29

2.3.7 HELICOPTER INSTALLATION

The installation of LORAN-C receivers in helicopters requires specialized procedures as helicopters possess special problems. The major problem in LORAN-C use for helicopters is in the size and placement of the antenna. An additional problem is in providing an adequate ground for the antenna in many helicopters.

An antenna location on the topside of the helicopter is preferred. The antenna is best located as high as possible. Bottom mounted antennas may not receive a good signal while the aircraft is on the ground. Bottom mounting provides more restricted space and requires an antenna with less vertical height, such as the A-17 Blade or A-23 Bent Whip Antenna. Bottom mounted antennas should be placed as far away from obstructions as possible. Be sure to also avoid the engine exhaust area.

CAUTION: Bottom mounted antennas cause inversion of the LORAN-C signal. A jumper connection on the Digital Board of the APOLLO II will compensate for the signal inversion see Figure 3. This internal connection change MUST ONLY be performed by the factory, a factory authorized repair station, or authorized dealer.

The antenna should be attached to structural metal for a common ground. If this is not possible, a metal plate or screen may need to be used to create a ground plane. The antenna ground must be connected to the preamplifier ground if a separate preamplifier is used.

The diagram below shows four possible antenna locations. Other locations may also provide good reception and proper installation. Choose the most practical site that will yield the best results. Be sure to avoid locating LORAN-C antennas too close to VHF or HF radio antennas. A safe distance for the LORAN-C antenna is at least 6 inches from a transmitting antenna emitting 25 W or less, and at least two feet away from a high power transmitting antenna.

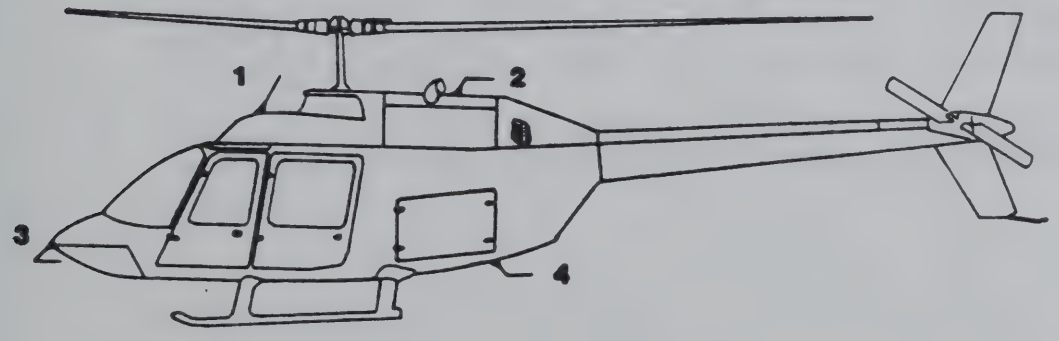


Figure 30

2.4 INSTALLATION CHECKOUT

This section describes a quick operational checkout to verify proper installation. If all installation manual instructions have been followed, proper operation of the APOLLO II is assured. This procedure does not provide a checkout of all operations of the APOLLO II, but provides a quick indication of correct installation. This checkout should be completed before the work area has been sealed should a problem occur. If you are unfamiliar with the unit, read the applicable sections in the Operation Handbook.

1. Check all power and ground connections before applying power.

2. Turn the power on. Check that the unit passes all tests and that all annunciators and display segments are functioning during the start-up self-test.

3. Check and record the Signal Levels and SNRs. Note the time necessary to cycle select. Perform this procedure with all other avionics off.

4. Check the position display with a known position coordinate. Do this by comparing the APOLLO II with another II Morrow LORAN-C receiver or by placing the aircraft near the Airport Reference Point. Do not perform this test inside a hangar or next to large buildings.

5. Define a distant waypoint as the destination and present position as the origin. Compare the bearing and range displayed with calculated values.

6. Check the CDI interface, if used.

    a. Enter a course offset (OFST) of 3.0 nm to the left. You should note a 3-dot needle deviation to the left. The XTD display should also show an indication to steer left.

    b. Enter a course offset of 3.0 nm to the right. You should note a 3-dot needle deviation to the right. The XTD display should also show an indication to steer right.

    c. Return to no course offset. The CDI needle should be centered and the XTD display should indicate you are on course.

7. Turn off the APOLLO II. Turn on all other avionics. Turn on the APOLLO II. Note the time needed for cycle selection to be completed. Also, check the Signal Levels and SNRs. Then compare the cycle selection time, the Signal levels and SNRs with those taken with the other instruments off. Cycle select times should both be within proper tolerance (for each cycle selection the time needed will be slightly different). Proper cycle select is from approximately 2½ to 5 minutes. Signal levels should be within 10 units with the other aircraft avionics either on or off. SNRs should read close to the same values with the other aircraft avionics either on or off (within ten units). SNRs may read a little lower than before due to the increased noise of the added equipment.

8. If the signal quality readings indicate a problem:

   a. Review all installation procedures carried out.

   b. Check all connections.

   c. Turn on the avionics one at a time to isolate the interference source and correct the problem.

   Note: Interference may be caused by the improper installation of other avionics or poor bonding of the aircraft ground.

APPENDIX A

FLIGHT MANUAL SUPPLEMENT

AND

STC CERTIFICATE

This appendix contains the supplement to the Partenavia P68C RAI Approved Airplane Flight Manual for the APOLLO II Model 612A LORAN-C Navigation System. This supplementary manual is specifically for the installation of the APOLLO II Model 612A noted as LORAN 1 in the Partenavia P68C. This particular installation had three APOLLO II Model 612As mounted in place. IFR operation refers to the LORAN 1 installation.

This supplementary manual may be used as a guideline in the preparation of Flight Manual Supplements for particular installations. See Appendix 2 of FAA AC-20-121 for examples of supplements to POHs or AFMs for other installations.

Also included in this supplement are the LORAN-C coverage areas approved for IFR navigation with the Model 612A. A composite map, as well as individual coverage by chain is provided. The shaded areas of the maps show where accuracy may be expected to be within 1.7 nm or better.

United States of America

Department of Transportation — Federal Aviation Administration

Supplemental Type Certificate

Number SA3806NM

This certificate, issued to: II Morrow, Inc.

certifies that the change in the type design for the following product with the limitations and conditions thereto as specified hereon meets the airworthiness requirements of Part 23 *of the* Federal Aviation *Regulations.* Effective February 1, 1965, and as amended according to the original type certificate data sheet, A31EU.

Original Product — Type Certificate Number: A31EU

Make: Partenavia

Model: P68C

Description of Type Design Change: The Apollo II Model 612A Loran-C navigation system is installed in the Partenavia P68C aircraft in accordance with II Morrow Top Level Drawing MC0050, Revision A, or later FAA-approved revisions. This installation includes a dedicated CDI and annunciator panel for the Loran-1 receiver, and provides steering signals to the autopilot. This STC allows II Morrow's participation in the FAA-sponsored, limited implementation program for evaluating the use of Loran-C during non-precision approaches.

Limitations and Conditions: This change in type design applies to the Partenavia Model P68C aircraft. This type design change should not be extended to other specific models of these aircraft on which previously approved modifications are incorporated, unless it is determined that the interrelationships between this change and any of those other previously approved modifications will introduce no adverse effect upon the airworthiness of that aircraft. A copy of this certificate and the FAA Approved Airplane Flight Manual Supplement must be kept in the permanent records of the modified aircraft.

This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of application: July 30, 1986

Date of issuance: March 23, 1987

Date reissued:

Date amended:

By direction of the Administrator

D. L. Riggin

(Signature)

Manager, Seattle Aircraft
Certification Office, ANM-100S

(Title)

II MORROW, INC.
2345 Turner Rd., S.E.
Salem, OR 97302
Document # D-281 Rev 0

FAA APPROVED SUPPLEMENTARY MANUAL TO RAI APPROVED AIRPLANE FLIGHT MANUAL FOR II MORROW, INC. APOLLO II MODEL 612A LORAN-C NAVIGATION SYSTEM WHEN INSTALLED IN PARTENAVIA P68C

SERIAL NO. _____

REG. NO. _____

This supplementary manual must be attached to the RAI approved Airplane Flight Manual (AFM) when the II Morrow APOLLO Model 612A LORAN-C Navigation System is installed in accordance with STC No. SA3806NM.

The information contained herein supplements the information in the affected basic RAI approved AFM. For limitations, procedures, and performance information not contained in this supplement, consult the basic RAI approved AFM.

FAA APPROVED: for Lester H Berven
Manager, Seattle Aircraft Certification Office
Northwest Mountain Region
Date 20 Mar 87

HISTORY OF REVISIONS

REVISION NO.	AFFECTED PAGES	DESCRIPTION	FAA APPROVAL
0		Original Issue	

FAA APPROVED DATE: MAR 20 1987

SECTION I LIMITATIONS

1. The II Morrow APOLLO Model 612A LORAN-C Navigation System Pilot's Operating Handbook, P/N 560-4001 Revision 0 dated March 1987, or later revision, must be immediately available to the flightcrew whenever navigation is predicated on the use of the APOLLO II Model 612A LORAN-C Navigation System.

2. IFR Area Navigation operation of the APOLLO II Model 612A is limited to the 48 contiguous states, and the District of Columbia with the following exclusions: see the attached charts in Appendix A.

3. During Area Navigation operation of the APOLLO II Model 612A additional navigation equipment required for the specific type of operation must be installed and operable.

4. The APOLLO II Model 612A LORAN-C Navigation System must be checked for accuracy (reasonableness) prior to use as a means of navigation after acquisition of a new GRI, or reacquisition of the same GRI.

5. During the APOLLO II Model 612A system start-up test the pilot must check the following items for proper operation prior to each IFR flight: External LORAN WARN annunciator, external LORAN VFR annunciator, CDI needle, and CDI flag. The pilot shall verify that all of the dots in the alpha-numeric displays are functioning. The pilot shall verify that both lamps are operational in the LORAN VFR and LORAN WARN external annunciators.

6. No flight operation shall be predicated on the use of the APOLLO II Model 612A LORAN-C Navigation System whenever a NAV OFF flag is displayed by the CDI. In addition, no IFR flight shall be predicated on the use of the APOLLO II Model 612A LORAN-C Navigation System whenever the external LORAN WARN or LORAN VFR annunciators are lighted, or the accuracy reasonableness check has a consistently greater position error than 3.0 nautical miles, or any failure observed during the system start-up test.

7. The pilot must verify the coordinates of each waypoint to be used during an IFR flight, including those waypoints used from the FLYBRARY data base.

8. The APOLLO II Model 612A LORAN-C Navigation System may not be used for IFR navigation during icing conditions.

9. In the Software Version pages of the SETUP Mode the following Operating System and Front Panel software versions will appear:

   OP 4.2

   FP 1.5

   IFR operation is permitted only if these software versions are displayed.

10. Only LORAN 1 may be used for IFR navigation.

11. LORAN-C IFR Nonprecision approaches are not approved except as part of the FAA-sponsored limited feasability program for LORAN-C IFR Nonprecision Approach. When approaches are conducted for this program, the following limitations apply:

    a. Special Instrument Approach Procedures for LORAN-C for 1) runway 10R at Portland International, Portland, Oregon airport and 2) runway 31 at McNary Field, Salem, Oregon airport are complied with.

    b. The Standard Instrument Approach procedure for the (e.g., ILS/LOC, etc.) 1) runway 10R at Portland International, Portland, Oregon airport and 2) runway 31 at McNary Field, Salem, Oregon airport are used as a monitor of LORAN-C performance by the pilot-not-flying.

    c. The approved LORAN-C triad has been selected and is in use prior to intercepting the final approach course.

    d. The current area calibration value (provided by TSC) has been entered into the LORAN-C receiver prior to intercepting the final approach course.

    e. A satisfactory LORAN-C accuracy check has been accomplished no later than the final approach fix inbound.

12. The LORAN-C approaches are not authorized or must be discontinued under the following conditions:

    a. The CDI indicator displays a NAV warning flag.

    b. The LORAN-C receiver displays any warning that indicates degraded or unreliable LORAN-C performance.

    c. The navigation source (ILS, LOC, etc.) used as a monitor indicates a failure or unreliable data.

    d. The navigation source used as a monitor indicates excessive (full scale) deviation from the standard instrument approach procedure.

13. Two pilots are required whenever LORAN-C is being evaluated in IMC or VMC conditions for NPA. The pilot-flying must monitor the LORAN-C and the pilot-not-flying must monitor the other navigation source.

SECTION II NORMAL PROCEDURES

A. GENERAL

Normal operating procedures are described in the II Morrow APOLLO Model 612A LORAN-C Navigation System Pilot's Operating Handbook, P/N 560-4001 Revision 0 dated March 1987, or later revision.

B. POWER SOURCE

The APOLLO II LORAN-C Navigation System power source is from the 12 or 28 VDC avionics bus. The system is protected with a 5 amp circuit breaker labeled "LORAN."

C. AIRCRAFT INTEGRATION

1. CDI Interface.

   a. The CDI will display only the following LORAN 1 derived information.

      1) CDI - left or right course information with full-scale L/R=5.0 nm (enroute scale) and 1.25 nm (approach scale).

      2) TO/FROM SYMBOL - The selected LORAN 1 course will take the aircraft TO/FROM the LORAN 1 waypoint.

      3) OFF/WARNING FLAG - LORAN 1 navigation is unreliable.

2. AUTOPILOT INTERFACE. To couple the LORAN 1 steering information to the autopilot:

   a. Define a To-From course in the LORAN 1.

   b. Select OMNI Mode on the Radio coupler.

   c. Place the NAV 1/LORAN switch to the LORAN position.

   d. Set the course on the CDI.

   e. Set the HDG bug in the Directional Gyro to the DTK in the LORAN 1.

   f. Engage the Roll and HDG switches on the autopilot console.

   NOTE 1: A LORAN-C Warning Flag will not disable the autopilot. If the LORAN WARN annunciator is lighted, the pilot must manually disable the autopilot.

NOTE 2: When the LORAN has sequenced to the second leg of a two leg course, the HDG bug in the Directional Gyro must be reset to the DTK of the new course leg and the CDI must also be reset.

3. Additional Normal Procedures for Approach Mode Operation

a. LORAN-C special instrument IFR approaches are approved as the primary means of navigation provided the standard navigation source used as a monitor is tuned and operable.

b. If the LORAN-C receiver fails during a LORAN-C approach in VMC conditions, the approach can be continued using the standard navigation source. Any discrepant LORAN-C accuracy or performance information should be recorded and reported to the local FAA FSDO.

c. LORAN-C accuracy checks are required prior to conducting a LORAN-C approach. This test must be conducted on an approved triad after the area correction value has been inserted into the receiver. This accuracy check is necessary to verify that cycle slip has not occurred. The LORAN-C position should check to within one nautical mile of the navigation reference (VOR, VORTAC, NDB, etc.).

d. Additional means to verify LORAN-C accuracy are as follows:

1) When the aircraft is established on an intercept leading to the final approach course note the LORAN-C CDI or digital crosstrack error display when the lcoalizer CDI centers. Crosstrack errors of ±0.3 nm or less or acceptable.

2) If the aircraft intercepts the LORAN-C final approach course prior to intercepting the localizer course, the pilot should observe the localizer CDI when the LORAN-C CDI is centered. Between the IAF and FAF points, a localizer CDI deviation equal to or less than full-scale indicates acceptable LORAN-C crosstrack errors.

NOTE: It is recommended that the pilot-not-flying advise the pilot flying of the magnitude and direction of the localizer deviation, i.e. localizer two dots right, localizer one dot left, etc., periodically during the approach.

D. FAILURES AND WARNINGS. The II Morrow APOLLO II Model 612A LORAN-C Navigation Navigation System annunciates failures or conditions in which LORAN-C Navigation is unreliable in the following manner:

a. LOW SIGNAL-TO-NOISE RATIO - the internal WARN and the external LORAN WARN and LORAN VFR annunciators will be lighted.

b. UNACCEPTABLE GEOMETRY - the external LORAN VFR annunciator will be lighted.

c. BLINK CONDITION - the internal WARN and the external LORAN WARN and LORAN VFR annunciators will be lighted.

d. CYCLE SLIP - the internal WARN and the external LORAN WARN and LORAN VFR annunciators will be lighted.

E. If a GRI change is required while in flight the APOLLO II may not be available for approximately 2 to 5 minutes before acquisition of the new GRI. Other appropriate means of navigation will be required until the LORAN WARN and LORAN VFR annunciators are extinguished.

F. LORAN-C OPERATION AREAS (LOAs). LOAs specified in the attached charts of this Flight Manual Supplement should be used for planning IFR flights based on the use of the LORAN-C system for navigation. LOAs are defined as approximate limits of coverage generally suitable for IFR navigation. The actual areas of suitable IFR navigation will vary as a function of ambient conditions. The warning flag(s) are intended to define the actual limit of approved IFR operation.

G. COMPUTER PROGRAM. The APOLLO II Model 612A LORAN-C Navigation System computer program identification numbers are displayed by performing the operations described below. The APOLLO II displays the computer software version numbers for the FLYBRARY (FB), Operating System (OP), and the Front Panel (FP). The FLYBRARY numbers refer to the effective date. The "OP" and "FP" numbers displayed should represent the computer program versions of the Operating System and the Front Panel shown in the History of Revisions of the APOLLO II Model 612A LORAN-C Navigation System Pilot's Operating Handbook, P/N 560-4001 Revision 0 dated March 1987, or later revision.

1) Press the MODE push button to reach SETUP Mode.

2) Turn the LIST (outer, large) knob either clockwise (cw) or counter-clockwise (ccw) to reach the FLYBRARY (FB) effective date. The FLYBRARY data base is updateable on a 56 day cycle based on the FAA Airport/Facility Directory. The FLYBRARY effective date is listed showing the Month, Day, and Year. See the example below.

   The FLYBRARY data base has been designed to be partitioned from the approved operating system software. This allows the FLYBRARY data base to be updated without reapproval. Therefore, the effective date shown below is only an example and may vary from that displayed in a particular unit due to updates.

```
                    FB 07036
                    -- -----
                     |  | ||
FLYBRARY ____________|  | ||_____ 1986 (6)
JULY (07) _____________|  |_______ 3rd day (03)
```

3) Turn the DATA (inner, small) knob one position cw to display the Operating System (OP) Version number. IFR operation is permitted only if this software version is displayed.

   OP VERSION 4.2

4) Turn the DATA knob one more position cw to display the Front Panel (FP) Version number. IFR operation is permitted only if this software version is displayed.

   FP VERSION 1.5

SECTION III EMERGENCY PROCEDURES - NO CHANGE

SECTION IV PERFORMANCE - NO CHANGE

FAA APPROVED DATE: MAR 20 1987

II MORROW, INC.
2345 Turner Rd., S.E.
Salem, OR 97302
Document # D-281 Rev 0

LORAN-C COVERAGE MAPS

FOR

IFR FLIGHT OPERATIONS

LORAN-C CHAINS

U.S. Composite Coverage . . . . . Figure 1

GRI 5990 . . . . . Figure 2

GRI 7980 . . . . . Figure 3

GRI 8970 . . . . . Figure 4

GRI 9940 . . . . . Figure 5

GRI 9960 . . . . . Figure 6

FAA APPROVED DATE: MAR 20 1987

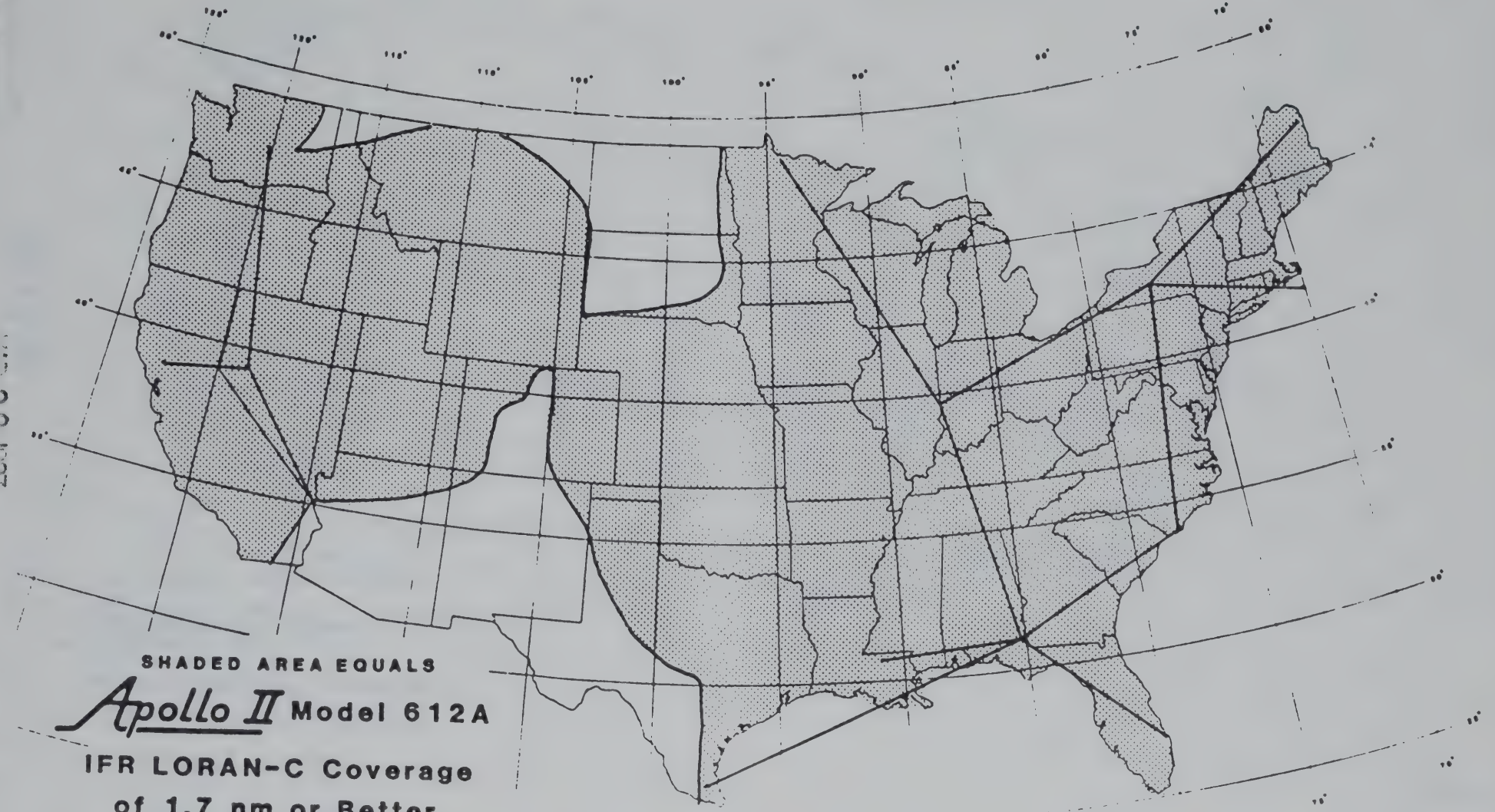

SHADED AREA EQUALS
Apollo II Model 612A
IFR LORAN-C Coverage
of 1.7 nm or Better
Composite Map Containing Chains
990, 7980, 8970, 9940, and 9960
May 9, 1986

Figure 1

FAA APPROVED DATE: MAR 20 1987

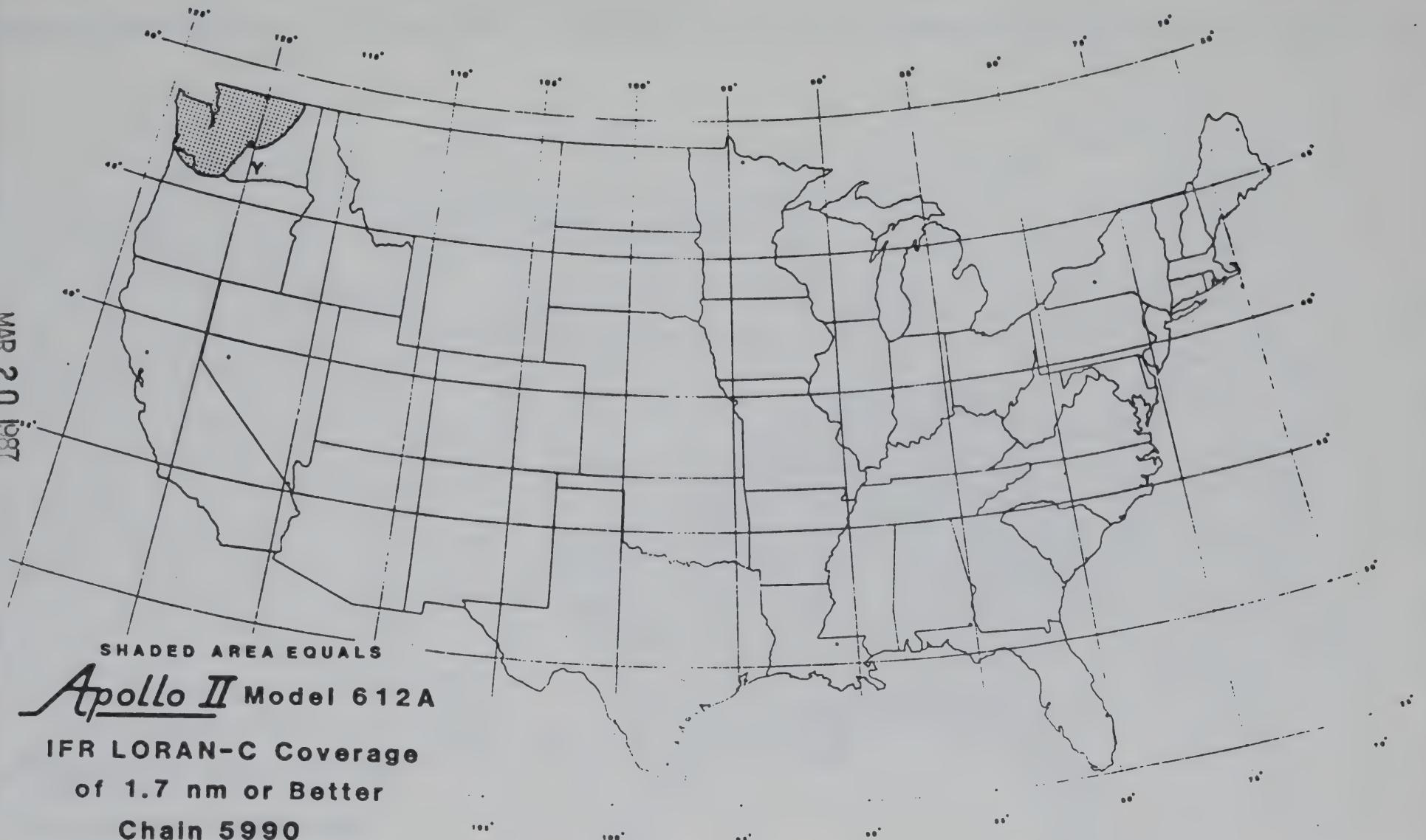


Figure 2

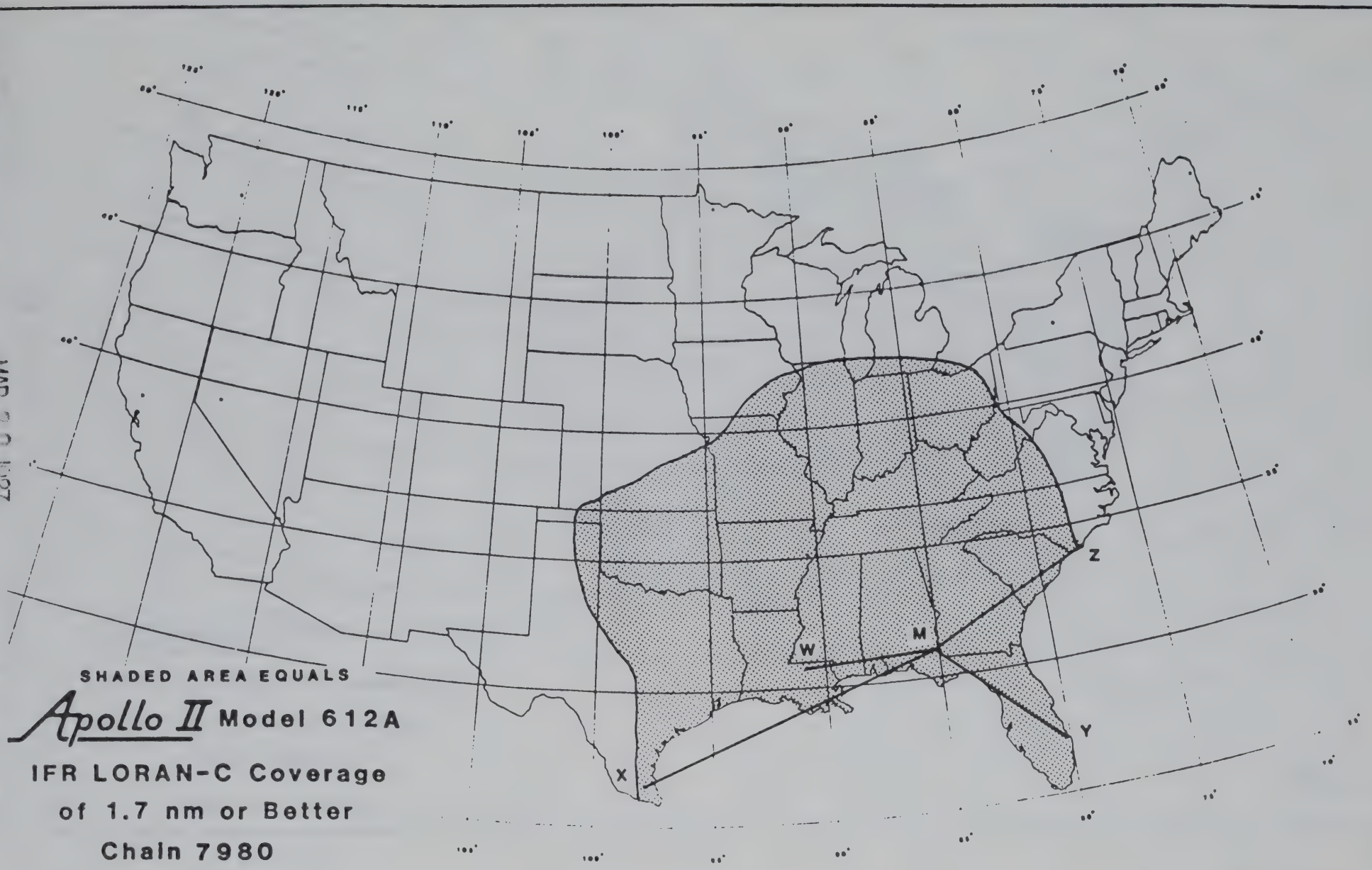
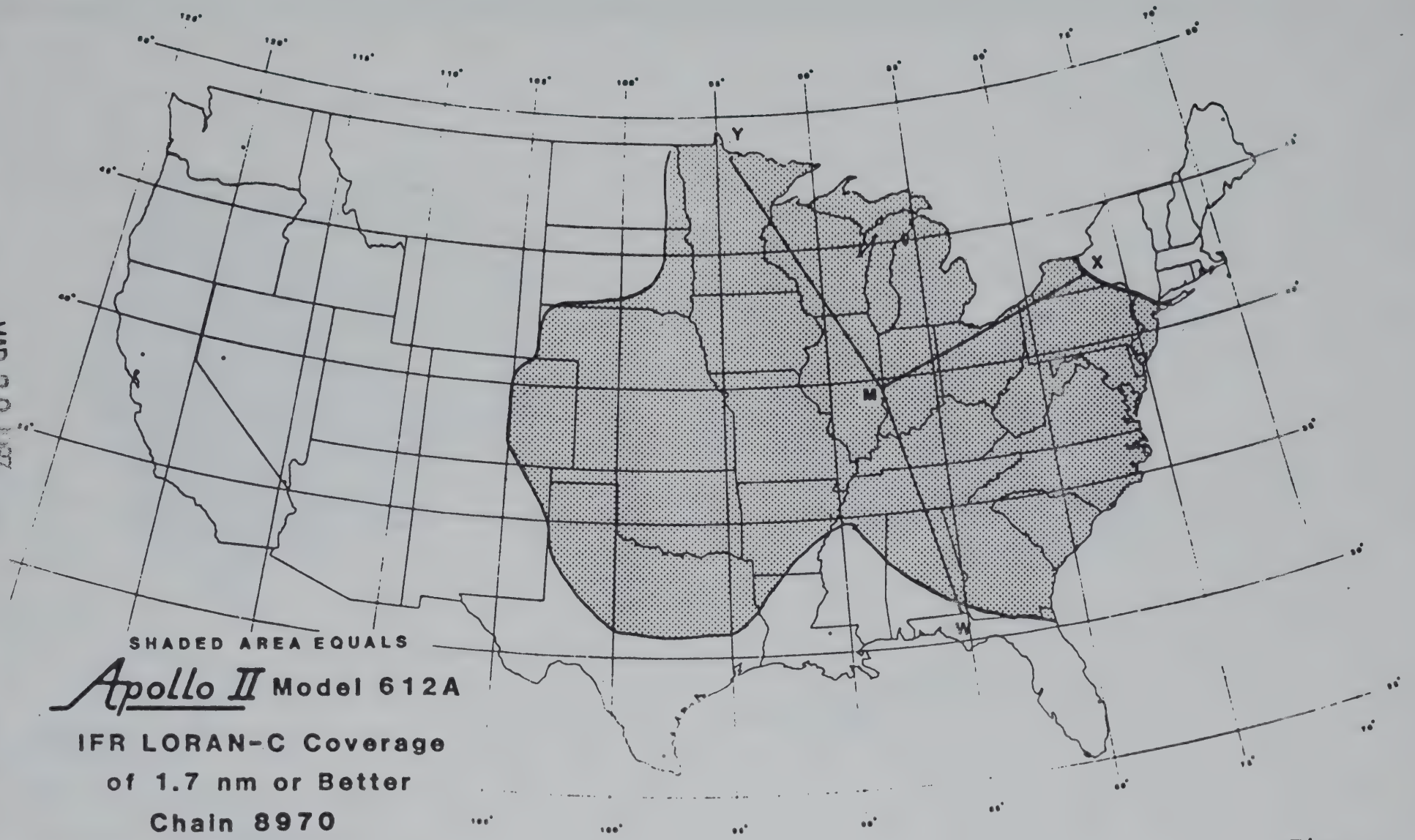

SHADED AREA EQUALS
Apollo II Model 612A
IFR LORAN-C Coverage
of 1.7 nm or Better
Chain 7980
May 9, 1986
X
W
M
Z
Y

Figure 3

FAA APPROVED DATE: MAR 20 1987



SHADED AREA EQUALS

Apollo II Model 612A

IFR LORAN-C Coverage

of 1.7 nm or Better

Chain 8970

May 9, 1986

Figure 4

FAA APPROVED DATE: MAR 20 1987

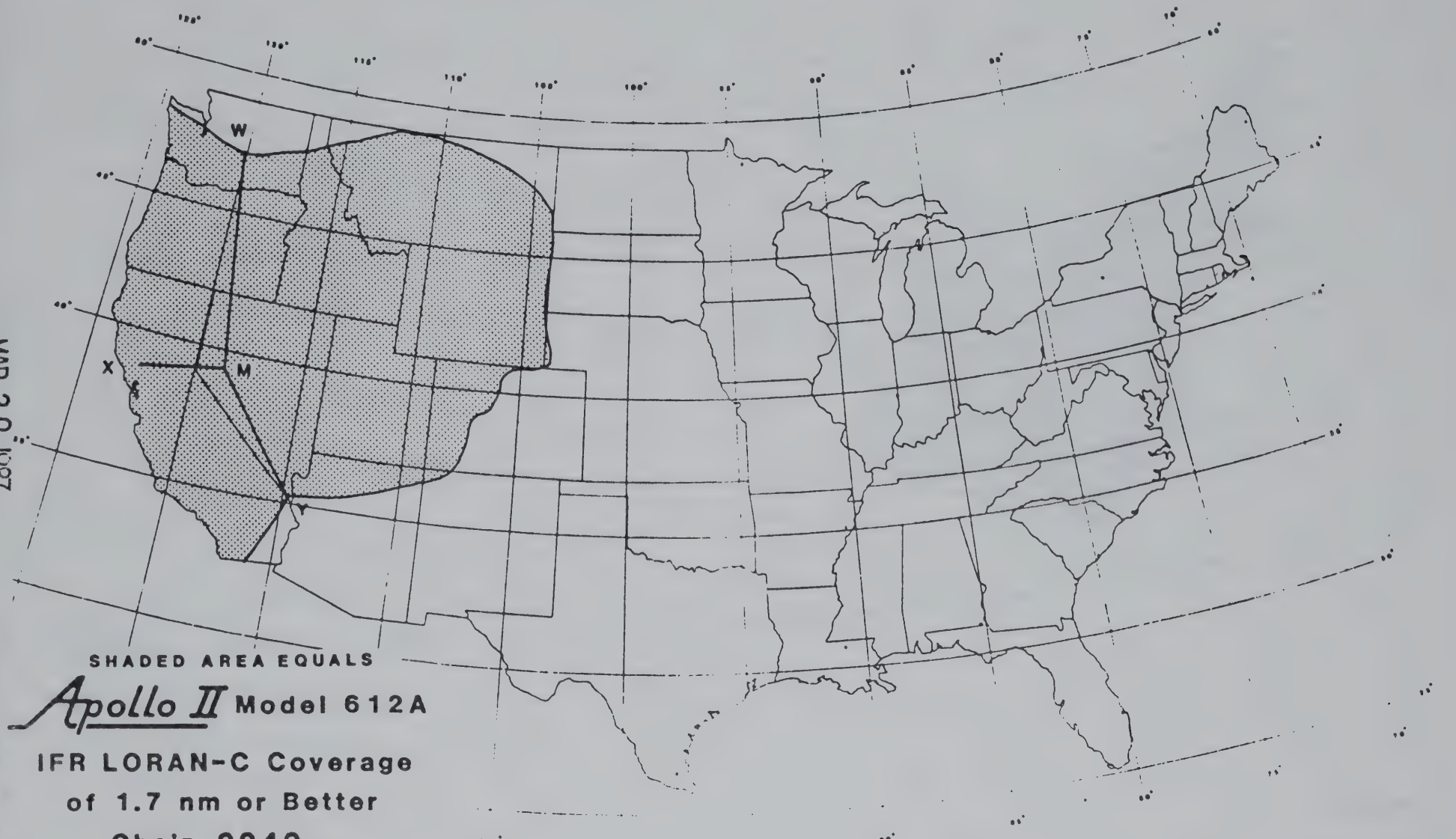
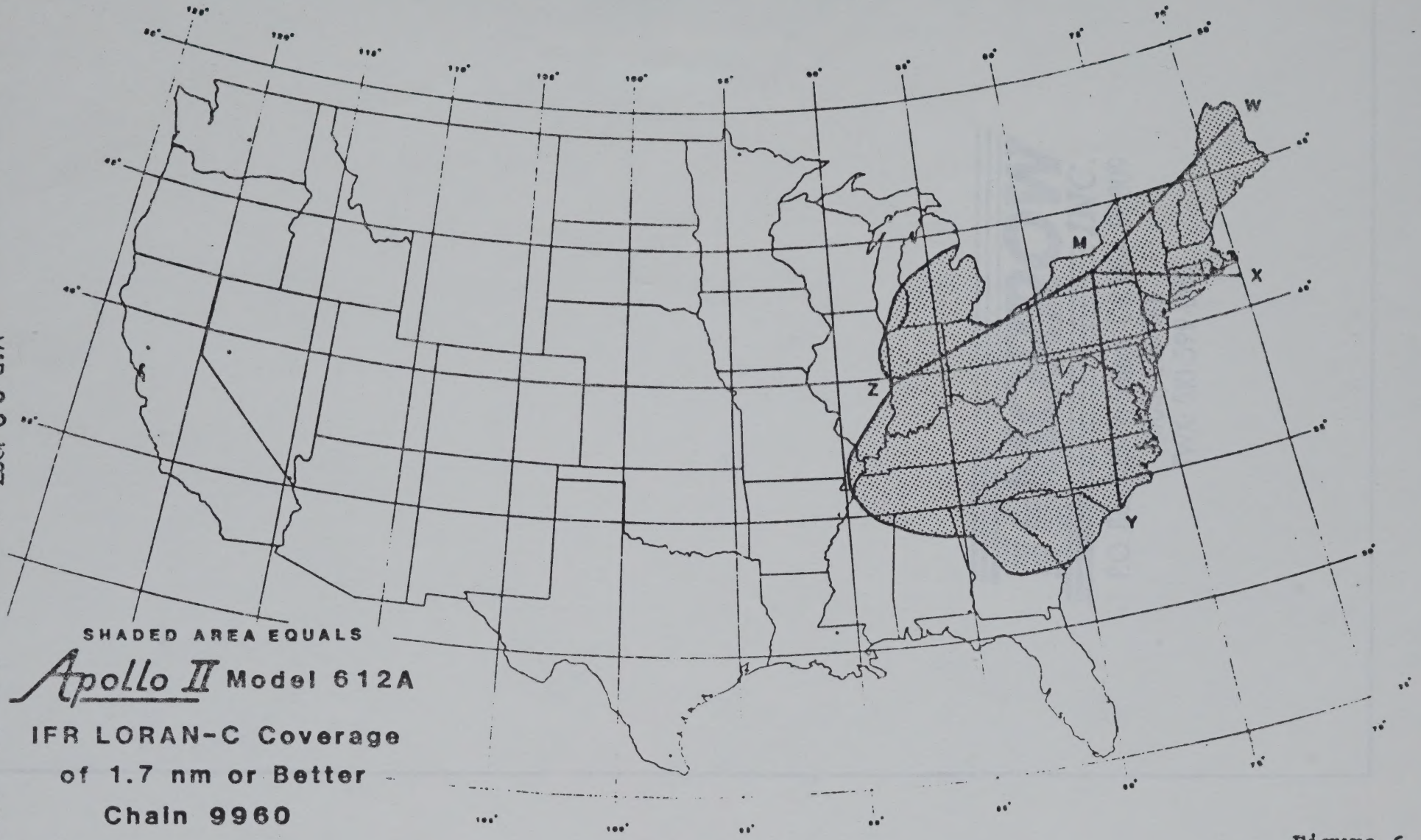


Figure 5

FAA APPROVED DATE: MAR 20 1987



SHADED AREA EQUALS

Apollo II Model 612A

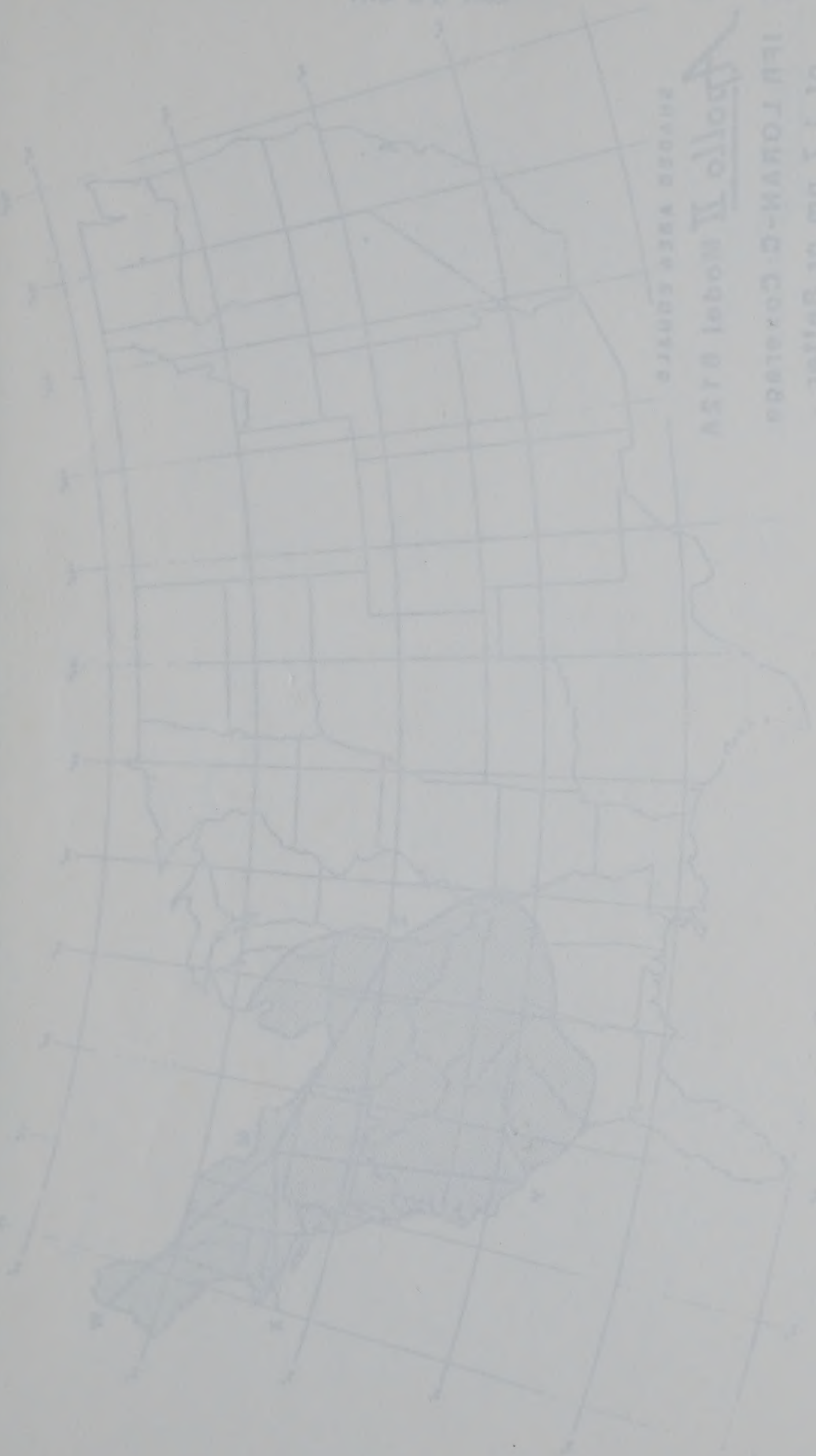
IFR LORAN-C Coverage

of 1.7 nm or Better

Chain 9960

May 9, 1986

Figure 6



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